Advancing Project Management by Applying Learning Theories for Designing and Delivering Professional Education Online

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A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Project Management

Graduate School of Business
Business Portfolio
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November, 2005
DECLARATION BY THE CANDIDATE

I hereby declare that the work presented in this thesis is, to the best of my knowledge, original except where acknowledged in the text. No part of this document has been submitted for a degree of any kind, at this or any other academic institution. Furthermore, the work presented has been carried out since the official commencement date of the approved research program.

Kenneth David Strang

November, 2005
ACKNOWLEDGMENTS

First I would like to thank my family, including my wife and my daughter, for their understanding and moral support throughout this four year PHD endeavor. Secondly I would like to thank my primary supervisor, Dr Derek HT Walker, Professor of the Doctor of Project Management (DPM) program (dhtw.tce.rmit.edu.au/pmg/) at RMIT University, Melbourne Australia (www.RMIT.edu.au), for his considerable effort and high caliber guidance.

Dr Walker helped me overcome many challenges to complete this process, including motivating me to stay focused and think beyond the status quo. No one is ever thanked enough for those ‘extra unpaid hours’ of work behind-the-scenes to help students and colleagues. Often those highly-qualified individuals such as Dr Walker are inundated most, since many people seek their assistance and wisdom - at times they must feel like a ‘well-beaten highway’. As I have learned in this DPM program, it takes more than just knowledge and skills to accomplish academic research goals... it takes qualified multi-year guidance, otherwise higher education degrees could be granted by international tests like driver examinations or professional certifications. Thanks Dr. Walker.

Thirdly I would like to extend my sincere thanks to the faculty, administrative, and technical staff at RMIT University. I had to overcome a difference in culture and academic process (as compared with my experience in North America) and RMIT helped me through that with compassionate understanding and helpfulness. Having gone through this program at RMIT now over four years, I am confident I can offer a qualified opinion as a client. I have also taken courses at RMIT that are beyond the DPM program (e.g. those in the business/masters area). To that end I would certainly attest to the broad subject matter and student-centered academic processes RMIT have in place. I would therefore recommend RMIT and the DPM to domestic as well as international candidates.

Fourthly I offer thanks to Dr Yölande D. Goodwin for her feedback on my analysis, models and research designs. Dr Goodwin understood adult education and statistics so she was able to quickly evaluate my ideas and suggest changes before I would have wasted years of effort in the field designing/delivering courses then gathering data that might have been unusable for my thesis. Thanks to my friends at the Université de Québec for any in-kind and/or financial assistance they have offered over the last few years. I would also like to thank the external examiners, both those on the ‘official list’ and the ‘others’ whom took the time to read and comment back on my completed thesis.

Finally best wishes to my colleagues in the DPM program at RMIT. Hopefully I have practiced what I theorized during the DPM in that I have created and shared some knowledge that my peers will find useful, as I have in-turn done with their peer collaborations. My thesis will be published in the digital library so others can read it just in case it might somehow help with their applied research and/or methods. Hopefully there will be something in there that will be useful to others, by way of a catalyst for generating new ideas, or maybe as a learning experiment.

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SUMMARY

Project management (PM) is a world-wide professional discipline that is gaining increased recognition because the theories and practices enable individuals, groups, corporations, and communities to achieve high-quality timely outcomes and stakeholder satisfaction by applying theory and best-practices. The PM profession is fueled through continuous education for learning, by certification to sustain industry quality standards, and via knowledge sharing to advance the practice beyond today’s social frontiers.

Peer discussion and self-reflection suggest a strategic way to advance the PM practice is to leverage adult-centered learning theories. A major constraint in continuing professional learning is PMs are busy and by nature of the work, forced to be mobile. Online learning appeals to PMs since demands from work, family, and personal interests compete with the desire to engage learning and finish courses. One dilemma challenging the stakeholder prism of expectations is that PMs, the profession, and organizations, seek more flexible online learning design and delivery methods. This exposes an opportunity in contemporary PM educational methods: to improve anywhere, anytime training contexts, that also motivates learning attention and volition.

Current research indicates there are gaps in educational psychology theory and practice, in that qualitative and quantitative studies of instructional design and delivery methods for online PM learning are lacking. This ‘gap’ between PM learning and practice is two-fold. First, the critical ‘soft skills’ were missing from PM training programs, namely transformational leadership, stakeholder management, knowledge creation, and meta-learning. Secondly, adult-centered models for online learning are immature since the virtual design and delivery infrastructure of the Internet for professional education is just beginning its life cycle. PMs need anywhere, anytime, motivating online learning.

Preliminary thesis research investigated the issue of critical ‘soft skills’ needed for PM training programs. Qualitative observations were made of PM training programs, from the perspective of both a student (in several online and face-to-face programs) and then as an instructor, to design and deliver several traditional (face-to-face) as well as online courses to professional adults. Current educational psychology literature was explored,
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and the PM stakeholder needs-analysis findings of the Project Management Institute were studied. The thesis then focused on learning context design and delivery methods.

Credible and effective models exist and were explored for online adult education creation and instruction, yet literature confirmed current research falls short of validating adult-centered online learning design and delivery methodologies. The idea of a professional learning model was created to guide the design and delivery of online adult education. This was informed from preliminary research as well as an extensive literature review to critically analyze current and historical educational psychology principles. The distinction of the thesis approach from extant literature is a perspective transformation of the fundamental educational psychology principles (traditional instructional design and delivery), to shift the philosophy towards an integrated (holistic) humanistic-constructivist paradigm for online professional adult learning. Four conceptual models were developed as ideas for guiding online professional learning context design and delivery. The key principles emphasized in this new approach are andragogical motivation, self-schema, self-efficacy, and self-regulation.

The preliminary research had concluded with several online teaching experiments in multiple adult learning contexts to qualitatively and quantitatively test the concepts (with positive results). A more extensive repeated-measures quasi-experiment was designed and conducted in a university’s (online) MBA program (n=48), using a scientific research methodology (that controlled the majority of the confounding factors) to empirically test the professional learning factor model. The paired-treatment tests, factor covariances, coefficient of multiple determinations, and cause/effect multiple regression findings were statistically significant at the 95% confidence level (most tests exceeded 99%). A linear mathematical predictor and systemic model was substantiated from the rationalized professional learning goal concept testing, to quantitatively explain 66% ($r^2$) of cause-effect variance between the contextual factors and dependent variables. These findings were compared to, and were in agreement with similar studies.

The limitations of the quasi-experiments are small sample size, natural selection (as opposed to pure randomization), and generalizability to other contexts (models not yet
replicated). These limitations could be overcome by replicating the experiments over diverse adult learning contexts (to include additional subject matter, more university cultures, more instructors, and multicultural professional students), by measuring before and after learner dependent variables, as well as to obtain much larger sample sizes.

This research makes a theoretical and empirical contribution to four stakeholder domains - PM professionals, adult educators, academic research community, and PM body of knowledge. First, for a busy and mobile generation of PMs, the educational psychology principles underlying the professional learning models are relevant and useful to facilitate cognitive and meta-learning. In a qualitative sense, they are self-reflected to be useful. In a logical positivist paradigm, they are proven to be effective, based comparable recent empirical studies, as well as from the thesis research (evidenced by students’ qualitative comments and quantitative measurements).

Secondly, for the adult educator, the theoretical construct can be used for course design and delivery, in both online and traditional modes. From a quantitative basis, this thesis and current literature confirms these humanistic factors improve online course design and delivery (again subject to their statistical and theoretical limitations as noted).

Thirdly, the academic community (researchers, instructors and students) can review the research methodology for insights in constructing their own experimental learning model. The synergistic tactic of integrating project management with scientific research methods for multi-year endeavors has proven useful to organize the work and decrease time-to-market for these results. Researchers and students can replicate the experiments, to validate or refute the theoretical principles and empirical findings, in other contexts.

Fourthly, the PM community can apply these concepts and constructs to extend the PM body of knowledge and practice research, toward the aim of improving anywhere, anytime, flexible professional learning, and also to promote the development of more ‘soft-skills’ content in PM training programs. The empirical evidence could convince organizations to invest more heavily in, as well as to apply, better PM learning methods.
1. INTRODUCTION AND APPROACH

This first chapter introduces the thesis research questions, the rationale, and the hypothesis. The gaps in current literature are highlighted (to be explored in Chapter 2), and the preliminary fieldwork is summarized (relevant published research is listed). It concludes with an outline of the remaining chapters and a meta-theoretical concept map.

1.1. Thesis Overview

The guiding thesis mission is to thoroughly explore a pivotal overarching research issue: how can the professional learning design and delivery approaches be improved such that the project management (PM) community of practice can further evolve. The secondary issue relates to how educational psychology, management, and social science principles can be leveraged to improve online professional learning. The third issue concerns how to theoretically address stakeholder satisfaction needs and learning challenges through online course design and delivery to professional project managers (PMs) who are busy, travel frequently, and are not motivated to complete training programs. The fourth issue concerns the content of PM professional learning, specifically the lack of complex cognitive soft-skills subject matter (such as leadership, ethics, knowledge creation, and resource/stakeholder management). Figure 1.1 conceptualizes this as an overview.

![Figure 1.1: Overall Thesis Research Approach](image)

It is the third issue above (as will be explained later), that will become the thesis research focus. Therefore, the objective of this thesis is to summarize key ideas and
findings from 4.5 years of research and action science experiments that explore the above issues. The aim is to critically review theory, identify gaps, explain key principles, and integrate experience, to build a model (and test it) for this vision:

Effective and efficient continuous professional learning, desired by working and often ‘mobile’ project managers (subject to frequent work context change), can be achieved through adult learner-centered principles, by harnessing critical epistemology from educational psychology (especially goal-driven motivation, self-efficacy, and self-regulation), while synergistically leveraging all resources.

1.1.1. Writing Style and Chapter Outline

In this thesis, the writing style is direct (first person) which is most appropriate for articulating the combined rationalistic and empiricist philosophy applied in the research (explained in chapter 3). Additionally, there is a large amount of self-reflective content. Readers may find it useful to refer to a glossary of terms and acronyms; the first time such terms are used I will format these in italic and underlined styles to indicate that these are included in Chapter 7 Glossary. Occasionally important terms are elaborated in footnotes immediately where applied when significant in the context.

This chapter begins by explaining the rationale for the study, first from an overall project management practice perspective, and then from an educational viewpoint. This is followed by an explanation of the research problems and hypothesis. This chapter includes a synopsis of the 4.5 years of thesis research and published papers, along with the key findings related to this thesis. The results of several action science\(^1\) experiments involving multiple online course pilots are revealed. These pilots played an important role in reflecting on theory; as well, the experiences-learned were applied here in this thesis to structure several commercial university program level experiments. The

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\(^1\) Action science examines “…the development themes from which […] practitioners may construct their theories…” Schön, D. A. (1983). The reflective practitioner - how professionals think in action, Aldershot, UK, BasiAshgate ARENA., by immersing oneself in the context to better understand the principles (p. 320), then use peer and self-reflection.
chapter closes with an outline of the thesis content followed by a meta-theoretical diagram (illustrating the broad concept integration underlying the thesis models).

1.2. Importance of Project Management and Professional Learning

The idea of improving the global project management practice through education was conceived from 21 years of international business and community development project leadership experience, and in particular, during the last seven years of adult teaching in the business sector. This thesis explores the ideology that the project management profession can be enhanced through improving online professional learning, by integrating principles from *educational psychology*, management, and social science.

The vision begs the question: why it is so critical to improve professional learning, or for that matter, why is project management (PM) itself so important to the world? “Why? Because it works” (Kerzner 2000, p. 13). PM is important for organizational growth and environmental sustainability (Labuschagne and Brent 2005). PM is used everywhere because the principles can be applied formally and informally to organize work, manage stakeholders, and guide teams, to get high quality work done on time, under budget, and exactly within scope (Cleland 1999; Turner 1999; Cooke-Davies 2002; White and Fortune 2002; Pennybacker and Grant 2003; PMI 2004).

Like most learned disciplines such as medicine, law, teaching, construction (to name just a few), PM practitioners need training, even beyond basic skills, such as those tested in the global *Project Management Professional* certification. Specifically PMs need more ‘soft-skills’ (Partington, Pellegrinelli and Young 2005) such as leadership, human resource management (HRM), knowledge creation, *meta-learning*, to compliment the ‘management core skills’ (technical capabilities such as scheduling, budgeting, communicating, presenting, quality assurance, risk management, etc.). A needs assessment of the global PM practice by the Project Management Institute identified leadership, people skills, program management, knowledge management, and specific industry knowledge as the most important competencies (PMI and Monalco Inc. 2003). Project management is an important subject matter in business disciplines (Briggs 2004; Arbaugh 2005a; Edgington 2005). Organizations that wish to survive need to view intelligent project management learning as a required action learning cycle.
Applying Learning Theory to Improve PM

Chapter 1: Introduction

(Cavaleri and Fearon 2000). Therefore, both professionals and corporations need to promote continuous learning (Austin 2004; Dunbar 2004).

Professional project management rewards deliverable-focused project management, which calls for organizational efficiency and effectiveness - continuous PM skills-improvement customarily remains an individual altruistic goal. Research concurs there is a tension between individual and organizational learning needs in that “work-related learning approaches are dominated by an economic-rationalistic output approach, which takes an instrumental view of work-related learning”, and thus professional-level learning often neglects the importance of adult education theory as well as the benefits of critical reflection (Woerkon 2004, p. 1).

The literature states that organizational management may be “holding back rather than promoting the development of competence – namely acquiring and applying higher-order conceptions. Senior managers who themselves hold lower-order conceptions may be poor role models, setting limited expectations and exhibiting lower-order behavior” (Partington, Pellegrinelli and Young 2005, p. 94). This suggests PMs need externally provided training and effective role modeling contexts, especially in the soft-skills domain often associated with senior leadership and management competency (but that which may be lacking in many organizations according to the article’s findings). This difficulty of continuous learning for working professionals is not a *phenomenological* assertion since it is based on the objective reality of being an experienced project manager and adult educator. Early ventures in mentoring business project leaders, and recent practice of teaching project managers, made me realize that there was a need for more knowledge sharing of best practices and theories, along with guidance about how to apply these better techniques in situational project contexts. This conviction that increased knowledge sharing was necessary for learning and stimulating innovation in our profession was strengthened and supported by peer dialogue emanating from this research (via online collaboration as well as international conference discussions). Essentially one real problem is that project managers first need to learn how to learn (to overcome busy schedules and faulty ‘personal theories’), and then they need to learn soft-skills, as well as how to apply theory to practice context.
1.3. PM Practice-Level Problem Statement

The academic and scientific communities point out that to address this discontinuity between continuous professional learning and organizational PM performance, a researcher needs to first articulate the epistemological domains that form the theoretical and/or practice gaps in the current project management body of knowledge. This shortfall in current project management theory and best-practice guidelines involve the critical ‘soft skills’, such as multicultural leadership, human resource/stakeholder management, knowledge creation, and continuous improvement through learning. These ‘soft-skills’ are difficult to learn. They cannot be cognitively memorized, mnemonically associated with acronyms, or furnished purely from knowledge taxonomies – they must be conceptually and socially practiced by professionals while being motivated to learn.

Contemporary research argues that even PMs with successful projects need continuous learning because individuals tend to repeat past approaches used on simpler, more defined initiatives, and these may (likely) not be sufficient for future complex strategic programs (Partington, Pellegrinelli and Young 2005). Upon a 4.5 year critical review of PM theory and self-reflection from 21 years of practice, I concluded there didn’t necessarily seem to be a lack of knowledge available, but instead, a lack of access to it when and where needed, along with a lack of volition to complete training programs, cognitively understand soft-skills, and then apply new theories, according to the situation. There were of course exceptions in my experiences with professionals who were highly skilled and ‘model’ project managers (who were learning out of interest and/or for continuous improvement). The adults I taught were driven almost solely by the monetary rewards, by the credibility of professional certification, and also partly by the academic requirement of larger educational programs. For example, many project managers are inundated with workloads leaving little time and interest for learning better methods. On top of that many employers expect staff to train during prime-time family intervals, and many companies specify high weighting towards PM-certification in hiring criteria (without regard for proven soft-skills). Project management has become recognized as a required knowledge element in many disciplines of undergraduate and graduate programs (such as MBA, Engineering, Computer Science, and Education). This places undue bias on superficial performance achievement rather
than on mastery goal accomplishments involving critical soft-skills such as leadership, stakeholder management, knowledge creation/sharing, and ethics.

Another perspective of the same problem is that lack of *andragogical* motivation, which I partly attribute to ineffective teaching methods by professors or mentors. Even the recent Project Management Body of Knowledge (*PMBOK*) third edition still does not emphasize the importance of adult learning principles, instead it points out that education is needed: ‘examples of training methods include: classroom, online, computer-based, on-the-job training from another project team member, mentoring, and coaching’ (*PMI* 2004, p. 228). Additionally it is argued here that the professional learning problem is due to a lack of learning goals and self-regulation applied by PMs to help them learn. In other words, we need to teach PMs how to learn, rather than just transfer the knowledge alone. This philosophy is promoted in literature that advocates finding ways for creating adaptive change (Seligman and Csikszentmihalhi 2000).

### 1.3.1. Education as Possible Problem Resolution?

Times have changed in higher education service provisioning, as we see institutions moving from brick-and-mortar instructor-led classroom lecturing towards just-in-time online self-regulated learning. This is partly driven by economic pressures and social cultures that have evolved into a busier and more mobile generation of global business professionals needing training on short notice and/or when the opportunity (and funding) permits. Additionally the advent of the Internet provides a ubiquitous medium for anywhere anytime educational delivery and real-time professional collaboration.

Adult learning for our future population of busy and mobile project managers (often already well-educated in management, computer and/or social science) will need structured learning environments which they can access from anywhere, at anytime, yet that which will motivate them to complete the training and allow them to monitor/self-regulate the entire process. From experience as both a professor and student of higher education it was obvious that such a mandate would require more than an e-syllabus and Powerpoint™ lectures posted to Internet-hosted discussion forums (Strang 2003; 2004b; Strang 2004a; Strang 2005a; 2005c; 2005f; 2005d).
1.3.1.1. Theoretical and Empirical Gap in Adult Educational Psychology

In essence, not only do PMs need to learn better soft-skills (meta-cognition, leadership, resource/stakeholder management), PM teachers and mentors need more appropriate methodologies to design, motivate and facilitate professional learning. The literature on adult learning theory argues that ‘no single conceptual framework exists that can be used to explain the complex phenomena of adult learning…no unifying theory of learning has emerged because of the complexity and diversity of the adult learning process’ (Yang 2004a, p. 2). As a result, this thesis research also explores this lack of a professional learning approach problem from an instructional perspective.

The gap in current adult learning literature exists between the contemporary application of traditional university and school-driven educational psychology theories, to online course design and delivery, without adaptation for different contextual factors and stakeholder needs. Despite the fact that many novel andragogical ideas and credible empirical studies have recently emerged, it seemed after thorough literature reviews that contemporary research and experiments are reframed from traditional educational psychology theories (a few good examples are: Manathunga 2002; Johnson and Aragon 2003; Snyder 2003; Barker 2004; Bata-Jones and Avery 2004; Comacchio and Scapolan 2004; McAlpine 2004; Vrasidas and Zembylas 2004; Arbaugh 2005b; Combe 2005; Moon, Birchall, Williams and Vrasidas 2005; Murphy and Tyler 2005; Neal and Miller 2005; Newton and Ellis 2005; Smith 2005). There is no proven online learning model.

Many andragogical-related theories and e-learning studies do not reveal much if any conceptual evolution to leverage the dynamic and virtual medium of the Internet, to effectively and efficiently satisfy the anywhere anytime flexibility needs of the professional adult learner (Beaudoin 2002; Gallini and Barron 2002; Johnson and Aragon 2003; Petress 2003; Duffy and Kirkley 2004; Maclellan 2005; Muir 2005; Peters 2005; Tynjala and Hakkinen 2005). For instance, comparable empirical studies confirm “very little is known about how the adult learner in e-learning is valued within corporate settings” (Waight and Stewart 2005a, p. 337). ‘What has adult education sent back in terms of theory? Not much” (Chapman 2005, p. 310). ‘Unfortunately, the theoretical justification for the pedagogy of distance education has not kept up with the
growth in its practice” (Webb, Gill and Poe 2005, pp. 223-224). “What changes rapidly is the technology, not the basic processes of learning. It is rather worrying that e-learning is sometimes interpreted in a narrow sense as referring to process of delivering digital information and study materials to people through the electronic media” (Tynjala and Hakkinen 2005, pp. 318-319). These writers identify the gap in current practice.

This lack of professional learning methodology is especially obvious in academia where brick-and-mortar lecture halls are giving market share to click-and-software virtual blogs\(^2\), meaning that people are opting to take alternative learning approaches as compared with the traditional university context. To further exacerbate this problem, e-learning educators and trainers may not be familiar with traditional educational psychology methodologies that could be applied for designing and delivering (online) courses to the professionals. Empirical studies, not hermeneutics, suggest this. Contemporary surveys of (North American) ‘e-learning teachers’ about their knowledge of educational psychology principles confirms “people don’t seem to know what works and what doesn’t in the way of instructional design” (Thalheimer 2002b, p. 8).

The gap in educational psychology (in terms of a just in time highly motivated approach to training professional PMs) has been closed somewhat by various online (Internet-based) project management training/certification services offered by companies and universities. However, from an exploration of several of these programs, it was obvious that they primarily focused on short-term knowledge transfer and/or on memorization for certification exams. Some university programs offered much richer andragogical approaches but they had very little online (if any) project management content. This is quite evident by taking a look at the current programs offered in this profession and by speaking with students familiar with (and possibly participating in) those courses. This identified gap between educational psychology methodologies and professional PM learning needs mirrors the title of this thesis. It is proposed from experience and research that a good strategy for advancing the global project management profession can be achieved by organizations and individuals applying emergent educational

\(^2\) Blogs are Internet-based threaded discussions organized under topics whereby multiple people collaborate asynchronously.
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psychology principles. Improved learning approaches could furnish developing PMs with the one competitive advantage that will promote the most longitudinal and strategic growth possible – continuous learning. The thesis builds and tests an online professional learning design and delivery approach that maximizes professional adult motivation, self-regulation, self-efficacy, and self-schema (explained in Chapter 2).

1.4. Pre-Thesis Research

The research in this thesis encouraged an investigative exploration of problems and improvements to current applied norms and techniques within the global project management profession. As explained in the introduction, early on in this program a proposition emerged from the research, which was that organizational learning, stakeholder management, and leadership behavior ‘best-practices’ were needed most to improve global professional project management.

It makes sense that an improvement to a global practice is necessary otherwise it cannot propagate, cannot further innovate, and cannot sustain its professional status, unless there is a substantive epistemology of principles, along with a flexible generative triple loop process allowing individuals to continuously learn and cognitively evolve (explored in earlier research: Strang 2003; 2004b; Strang 2004a). In this sense it became apparent that adult learning and knowledge creation/sharing were actually core principles driving these propositions that in theory suggest the global art of project management practice could be enhanced through the application of learning principles.

Table 1.1 summarizes the preliminary research concerning theoretical explorations, case-based studies, model development, learning experiments, and teaching pilots, in partial support of the above. These details relate back to the overall approach portrayed in Figure 1.1. Additional research has been completed and published beyond that listed in Table 1.1, and is reflected in the work and references cited later in this thesis.

Table 1.1: Preliminary Thesis Research Synopsis

<table>
<thead>
<tr>
<th>Research Category</th>
<th>Key Outcomes and/or Published Deliverables</th>
<th>Thesis-Related Findings</th>
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<tbody>
<tr>
<td>Project Stakeholder Management,</td>
<td>1) Strang et al. (2002); &quot;Procurement and Ethics.&quot; A collection of 14</td>
<td>1) Stakeholder management and relationship alliancing are the most critical factors for successful project procurement management.</td>
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<td>Research Category</td>
<td>Key Outcomes and/or Published Deliverables</td>
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<tr>
<td>Procurement and Ethics</td>
<td>unpublished wholly theoretical short essays (with several case studies).</td>
<td>2) Case study of ICD, Lucent &amp; IBM illustrating why an ethical code of conduct should be developed and assimilated into every corner of the organization.</td>
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<td></td>
<td>2) Christenson, Norrie, Strang (2002); ‘Ethical Business Decision Making in Project Procurement Processes.’ Jointly authored multiple-case observation design unpublished essay.</td>
<td>3) Recommended contingency approach to RFP (including ethics and alliancing), to select best project management (based on NBDOE ‘education dept’ ERP/HRM system case study).</td>
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<td></td>
<td>3) Strang (2002); ‘Best Value RFP: Case Studies of an Ethical Approach.’ Single-case observation design unpublished essay.</td>
<td>4) Organizational learning principles need to be ‘designed-in’ projects at the start (in the project charter document).</td>
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<td></td>
<td>4) Strang (2002); Knowledge transfer, organizational learning, and innovation in project procurement.” Single-case correlation design unpublished essay.</td>
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<td>Knowledge Management</td>
<td>5) Hasandedic, Arroyo &amp; Strang (2003); ‘Knowledge environments: three industry perspectives.’ Unpublished jointly-authored multiple-case theoretical paper.</td>
<td>5) Importance of intellectual capital, business environment &amp; knowledge management, for increasing innovation &amp; learning.</td>
</tr>
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<td>Stakeholder management</td>
<td>6) Strang (2003); ‘Procurement, Management &amp; Ethics (case studies).’ Peer-reviewed wholly theoretical paper presented at local professional engineering educational development conference.</td>
<td>6) Professional code of ethics are necessary because most people apply a bounded rationality structure to make ethical decisions (which may not be socially equitable or satisfy stakeholders unless there are documented guidelines).</td>
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<tr>
<td>fieldwork</td>
<td></td>
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<tr>
<td>Knowledge Management</td>
<td>7) Strang (2003); ‘Practical Explorations in Knowledge Management.’ Unpublished theory/correlation design paper.</td>
<td>7) Philosophical origins of knowledge revealed: ‘...cartesian dualism does not apply in that the perspective of the knower, whether it is a group or individual, cannot be entirely separated from the context(s) and knowledge object(s), and furthermore, that what is known is a justified perception, not an absolute truth, and it could change over time and cultures.’ The knowledge environment as I had described it was the structural, process and cultural aspect to knowledge management and is likely provided by the organization (wherein explicit knowledge is captured using technology). Discussed alternative methods and models to assess knowledge management maturity.</td>
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<td>Reflective Learning</td>
<td>8) Strang (2003); ‘Learning &amp; Knowledge Management Characteristics.’ Peer-reviewed correlation design paper presented at local New Brunswick project management chapter professional development event.</td>
<td>8) Business perspective to knowledge management and organizational learning (SWOT, innovation, HR Mgt importance).</td>
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<tr>
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<td>Thesis-Related Findings</td>
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<td>Organizational Learning</td>
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<td>9) Organizational learning model developed, defined as: “...a theory of action [that] constitutes a conscious, repeatable, inspiring, entity-wide process of creating, acquiring, understanding, sharing, applying, improving, and managing social, tacit, and explicit knowledge in support of the organization’s purpose, strategies, and goals. The learning organization is an entity that is able to practice and leverage learning, in a repeatable process, on a progressing timeframe, by inspiring, guiding and leading individuals, stakeholders, and partners. Organizational learning, as with individual and group learning, should be viewable conceptually (like a model) as a systemic process with a feedback/adjustment mechanism in a repetitive/iterative loop, which is embodied in the improving attribute of this definition.”</td>
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<tr>
<td>Project Management Leadership</td>
<td>10) Bower, Manu &amp; Strang (2003); ‘Project Start-Up, Stakeholders and Leadership (Two Case Studies).” Jointly authored multiple case study design unpublished essay.</td>
<td>10) ‘contingency [stakeholder management] approach is necessary, customized to the organizational context, while employing theories from (Turner and Cochrane 1993) and (Briner, Hastings and Geddes 1996) and others, as a descriptive and prescriptive approach...both the typologies could be combined to improve the project initiation cycle, since they each analyze different aspects, and promote approaches to different weakness categories...[this new model is] a simpler typology to use for communicating the project typology assessment to the key stakeholders, especially the sponsors (the ones who make the go/no-go decisions).”</td>
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<td>11) Bower, Manu &amp; Strang (2003); ‘Organisational Structure, Teams &amp; Culture (Case Studies).” Jointly authored unpublished essay.</td>
<td>11) “It is suggested that there is a natural balancing between organisational structural architecture, structural ideology, and culture ...organisational culture and the macro environment will control the organisational design (architecture and ideology).” Importance of COP and radix organisational team structures.</td>
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<td></td>
<td>12) Strang, Bower &amp; Manu (2003); ‘Leadership Style, Transformation and Power Applied to Case Studies.” Jointly authored multiple case study design unpublished essay.</td>
<td>12) “Given the emphasis on the project management soft-skills along with the increased globalisation/competition in the profession, project managers often find they must manage diverse and distributed teams...which requires motivation and transformational leadership.”</td>
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<td>13) Strang (2003); ‘Leadership versus Management: Which is more critical for project success?’ Wholly theoretical paper presented at New Brunswick project management chapter event.</td>
<td>13) “Leadership and management are complimentary and both are typically required in most situational roles, both at the organizational level, and in the project domain. Kotter advocates the importance of sustaining a balance between leadership and management in saying: ‘the real challenge is to combine strong leadership and strong management and use each to balance the other’; furthermore, he notes that while they are different, both leading and managing are necessary for survival in today’s business environment.” Plus alternative leadership theories. Leadership must be practiced by all key stakeholders (sponsor too).</td>
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| Project Management Leadership Reflective Learning | 14) Strang (2003); “Project Management Leadership Reflective Learning.” Unpublished wholly theoretical with multiple | 14) “holistic yet balanced application of multiple leadership and management science principles are necessary for today’s dynamic, performance-driven, multi-cultural team-based project management, is shaping up to be a future research goal, which will advance the practice
<table>
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<th>Research Category</th>
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<tbody>
<tr>
<td>fieldwork</td>
<td>case design paper. Peer-reviewed (revised) paper presented at New Brunswick provincial project management chapter Annual General Meeting.</td>
<td>state-of-the-art.” Macro-level retrospective on the highlights of leadership theories related to project procurement/ethics, and knowledge management. This research also highlighted critical soft-skills epistemology and best-practice taxonomies covering topics such as leadership, stakeholder management.</td>
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<tr>
<td>Fieldwork Linking Grounded-Theory with Empirical Studies in Leadership</td>
<td>15) Strang (2004); ‘Effective Project Leadership Integrates Management Traits and Behaviors.’ Peer-reviewed multiple case study paper presented at NB Association of Professional Engineers &amp; Geoscientists joint event with Project Management NB Chapter. 16) Strang (2005); ‘Examining effective technology project leadership traits and behaviours.’ Double-blind-reviewed multiple case study correlational design paper published (in-press) in <em>Computers and Human Behaviour</em>.</td>
<td>15) Importance of influence in project leadership, which emphasizes transformational leadership approaches over transactional. Alternative trait theories and learning capabilities examined. 16) “. . . an effective project leader can assess the circumstances, consciously select skill(s) to apply in the situation, and act out beneficial project leadership behaviors, without necessarily having a contextually-advantageous personality propensity to behave in a supportive way, which repudiates the hypothesis that effective project leaders need a personal competency and personality combination that is conducive and complimentary to the dynamic project management role.” “. . . Therefore, inductively, it is proposed that effective project leadership behaviors can be learned and applied. In the same manner, leadership skills, behaviors, and processes could be proximally learned and improved at any level in the organization or community.”</td>
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<td>Fieldwork Linking Grounded-Theory with Empirical Studies in Dynamic Leadership + PM Learning Subject Matter</td>
<td>17) Strang (2004); ‘How Dynamic Leadership Improves Insurance Projects.’ Peer-reviewed multiple case study paper presented at Life Office Management Association Insurance Systems Forum New Orleans. 18) Strang (2005); ‘Exploring Dynamic Project Management using Situational Leadership Theory.’ Double-blind-reviewed multiple case study observational design paper published (in-press) to <em>Project Management Journal</em>.</td>
<td>17) Insurance industry case study illustrated how successful project leaders used a situational approach to team motivation; the underlying principles applied for team improvement were contextual development and learning goal theory. 18) Process view of project leadership theories, advocating that a contingency, situational approach is needed, proven through four case studies. This research pinpointed many of the critical leadership soft-skills (processes) which project managers need to learn in addition to the administrative and organizational project management related duties.</td>
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<td>Action Learning and Empirical Studies in PM Learning Subject Matter and Methods</td>
<td>19) Strang (2004); ‘Organizational Project and Human Resource Management.’ Online courses designed and delivered to MBA, MScs, and PM groups. Project Management course piloted at Queensland University of Technology, AU and Pearson International</td>
<td>19) Andragogy &amp; Pedagogy theoretical models developed, supported by qualitative student feedback and qualitative participant performance analysis. Learning goal theory, contextual development, self-regulation, andragogical motivation, and self-efficacy. Course designed and delivered (with eSyllabus, lectures, assessments) using CourseCompass, ElluminateLive, and proprietary university systems.</td>
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<td>Research Category</td>
<td>Key Outcomes and/or Published Deliverables</td>
<td>Thesis-Related Findings</td>
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<tr>
<td>Action Learning and Empirical Studies in PM Adult-Centered Learning Models</td>
<td>CourseCompass.</td>
<td>20) Strang (2004); “Applying Learning Goal Theory and Relational Database Design to Web-Based Education Creation and Delivery.” Theoretical with quasi-experimental design paper published (double-blind-reviewed) at North America Web conference. 20) “The most important elements in course delivery standout as instructor leadership and instructor confidence (nurtured through experience and continuous professional development), which facilitates sustaining the critical psychological motivation, basic cognition, concept mastery, and self-efficacy.” “In the field studies, it was not necessarily the quantity of instructor involvement or knowledge provided, but the quality, timing and how it was provided which accounted for the success, and also explained earlier failures. Effective and efficient course design subscribed to collective organizational support, instructor leadership/motivation, as well as to learner motivation and empowerment (with the only exception noted being that some students self-learned regardless of either the instructor’s delivery method and/or course design quality).”</td>
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<tr>
<td>Linking Grounded-Theory with Empirical Studies in Transformational and Team Leadership</td>
<td>21) Strang (2005); ‘Examining Effective and Ineffective Transformational Project Leadership.’ Double-blind-reviewed correlational multiple case study paper published (in-press) to Team Performance Management Journal.</td>
<td>21) “…project leaders from multiple international industries examined …do consistently practice more of the transformational leadership principles, as compared with the lassie-faire style approaches, but not necessarily to an observable extent in all situations which seem conducive to their application, respectively.” 22) “ Leaders whom practiced at least a moderate amount of transformational behaviors and very little (if any) lassie-faire, absent or unproductive behaviors, were more successful as judged by more effective and efficient organizational level deliverable production …as well as higher group level stakeholder satisfaction …” 23) “ Lassie-faire project leadership styles (negative/absent transformational leadership behaviors) resulted in lower project efficiency and team satisfaction; moreover, group participant reflections noted that both transformational and lassie-faire style project leader behaviors were noticed by team members.” 24) “Contrary to the main hypothesis, project leadership does not always require strong transformational leader behaviors to produce effective organizational outcomes, although applying individualized consideration, intellectual stimulation, inspirational motivation, as well as idealized influence, towards team members, tends to improve follower satisfaction and the leader-follower relationships.” 25) This research also highlighted critical leadership behavior best-practices.</td>
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1.4.1. Synopsis of PM Learning-Related Preliminary Findings

Certain key themes for project management best practices were emphasized in the literature, and were also perceived from deep reflection of 21 years of professional international project management consulting (plus my seven years of adult teaching).
Some of these guiding principle themes were concerned with the hands-on practice itself, while others were in support of its social and cognitive evolution (such as knowledge sharing and contextual learning). The following are proposed as guiding principles supporting the development of an improved project management practice:

✿ Knowledge improvement by developing learning content for:
- Situational leadership (multicultures, virtual teams, various contexts, many organizational climates/industries, transactional-transformational styles);
- Stakeholder management/team involvement, sponsor accountability;
- Human resource management/communication;
- Situational and contextual application of basic project management processes and epistemology;
- Organizational program-project integration, knowledge creation/management, product-project life cycle integration and stewardship;

✿ Practice improvement by developing guidelines suggesting ways to increase:
- Innovation, knowledge creation/sharing/management;
- Human resources development;
- Organizational meta-learning (collective learning attitude);
- Adult centered learning (motivated individual learning, learning to learn, complex cognitive development, contextual practice, learning in action);
- Symbiotic societal-business-professional practice competitive advantage linkages;
- Global practice recognition and professional continuity.

A critical best practice baseline comes from the *Project Management Body of Knowledge (PMBOK)* which is a global best practice set of core processes and epistemology used by almost every discipline around the world which uses project management (ie. Military, community development, engineering, health care, technology management, plumbing/construction, etc.). Therefore this PMBOK (PMI 2004) must be somehow referenced and integrated into contextual organizational
learning and situational best-practice models if it is to be taken seriously by practicing professional project managers around the world.

The PMBOK documents the global and generally accepted five processes and nine knowledge areas of professional project management practice (PMI 2004). It is critical that this PMBOK becomes the foundation of research aimed at advancing the theory, otherwise, such attempts inherently overlook accepted theory, proper research steps and knowledge management principles.

The PMBOK acknowledges that “soft skills are particularly important to team development…skills such as empathy, influence, creativity, and group facilitation are valuable assets when managing the project team” (PMI 2004, p. 228). The practical experience and research undertaken for this thesis argues that additional types of soft-skills are needed, such as leadership, stakeholder management, knowledge creation, and meta-learning. Furthermore, leadership, resource/stakeholder management in particular are cross-functional disciplines needed for both general and project management, and are of course critically needed in the latter field. Likewise, leadership and resource/stakeholder management are not well explained nor documented in the PMBOK (as compared with the other process groups and specific knowledge areas). The literature contains some confusion on one aspect of stakeholder management as well in that vision creation for example is typically an executive / senior management function (with appropriate stakeholder involvement), and not usually a project management activity (unless that were one of the goals and deliverables of the project). Instead, vision alignment, sharing, and integration are necessary for stakeholder management, scope management, and to a lessor extent for the other eight knowledge areas of PMBOK. Knowledge creation, sharing, and continuous learning are not addressed in PMBOK.

1.4.2. PM Professional Learning Research Problems

The preliminary research in the thesis was focused upon building, analyzing, and then synthesizing ideas building upon the PMBOK. To do this, courses were designed and delivered through online and face-to-face modes. The content of these courses focused
on the critical soft-skills mentioned previously: stakeholder management/ethics, knowledge management, leadership, and organizational/adult learning. Also the purpose of the courses was to experiment with adult-centered design and delivery approaches. The pre-thesis teaching pilots were field experiments in project management related content design, adult learning theory exploration, development, and application at the group level of analysis. Using pilots is in keeping with good project management methodology (Turner 2005) and “another purpose or side effect of pilot studies often emphasized is the learning they provide for organizations” (p. 5).

Although it could be argued that such research should examine theory and practice behaviors from multiple levels of analysis (society/industry/country, organization, team, individual) to uncover baseline best practices (as in the earlier preliminary research), it was reasoned that project management and learning are actually individual activities practiced in these multiple modalities and contexts. Therefore, ultimately the theory must be understood and applied by the individuals at all of these levels. This concept is well supported in psychology (not surprisingly) through idiographic research (e.g. case studies, subject observations) which advocates studying individuals rather than the group/organizational level (nomothetic approach) to best explain cause-effect behavior outcome (Zechmeister, Zechmeister and Shaughnessy 2001, p. 12). Nevertheless, some of the research benefits from a team analysis, so a holistic combination of individual and group levels of analysis was used to study the key thematic and contextual principles for ideas about project management practice improvement.

1.5. Thesis Research Questions

The key problems identified through the preliminary research for the thesis focus were:

1) What theories would best serve to guide the knowledge creation/sharing processes;
2) Which teaching methods would best serve global project management development.

These essentially reduce to thesis focus on course design and delivery. This thesis is therefore centered on developing and testing an improved methodology for ‘how’ to help project managers effectively and efficiently learn. Subsequently, developing and measuring the effectiveness of the ‘what’ (subject matter content) in advanced project
management learning (critical soft-skills subjects such as leadership, human resource management, ethics, and knowledge management) remains a goal for future research.

1.5.1. Hypothesis

The above can be synthesized into a single thesis of research interest. This thesis will present research hypothesis and findings that support and constitute a developed holistic model for applying motivational and constructivist professional online design and learning theories towards improving the global practice of project management.

The hypothesis ($H_1$) is that PM professional learning can be improved by applying adult learner-centered principles, in particular goal-driven motivation, self-efficacy, self-regulation, and self-schema to design and deliver online training, with success determined by measuring aggregate outcomes of course performance and satisfaction.

- $H_0 =$ the business-as-usual teaching methods will be just as effective as novel or emergent approaches, in terms of PM (student) GPV score and satisfaction levels.
- $H_1 =$ applying professional learning approach (including key principles of andragogical motivation, self-regulation, self-efficacy, self-schema) will increase PM (student) GPV performance scores and increase PM satisfaction levels.

1.6. Pre-Thesis Online Design and Teaching Pilot Findings

As explained earlier, this thesis does not attempt to build a professional learning model tabula rosa (from scratch). This thesis is informed by theoretical reviews and action science learning from the pre-thesis work (reported in: Strang 2003; 2005g; 2005b; 2005e). In particular, several online courses were developed and delivered to project managers as “pilots”, using the infrastructures of several international universities (reported in: Strang 2004a). One significant pilot project consisted of two online courses designed and delivered by the author to international PMs. The first was an “Organizational Project Management” course, and the second was a “Project and Human Resource Management” course. Both were delivered in Pearson International’s CourseCompass facility. Another online course was co-facilitated by the author and a peer PM at the Queensland University of Technology, again all on a volunteer basis, with volunteer participants. Several additional online courses were tested at a commercial university to MBA level students (as a no credit, no cost, course). Theses
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pre-thesis projects adhered to proper ethical research processes (as will be discussed in Chapter 3). The commercial universities involved in the pre-thesis pilots, and also participating in this thesis quasi-experiment, considers their work innovative, and a competitive advantage.

The pilot teaching experiments were preceded by years of practice in designing and delivering face-to-face courses to adults, often including project managers. For example, the author designed and taught over 30 project management related courses in face-to-face mode to local PMs, on behalf of the (non-profit) Project Management Institute, on a strict cost-recovery basis (charging participants only for textbooks, meals, materials, facilities rental, and exam fees). The author has been designing and teaching courses since 1997. Experiences from all these online and face-to-face “pilots” were aimed at professional PM learning and served as theory-building input to the thesis.

Chapter 2 will articulate the theory and rationalized models that were created during the pilots (and updated in this thesis). The original models were improved from the ‘teaching experiment pilots’. Nevertheless, empirical findings from the pilots showed strong support towards the thesis’s hypothesis, namely (Strang 2004a, pp. 12-13):

**Summative** indicators from the control group (previous course instances and peer instructor led courses), as compared with the (second version) goal-based pilots, show higher marks for the students in the test group, which were randomly selected except for (invited to) one project management course. Qualitative surveys were unanimous in confirming that the stakeholders were more satisfied in the test groups.

Preliminary quantitative assessments using a two-way upper-tailed analysis of variance test (without replication), applied for two courses (compared against two previous courses respectively) indicated that much of the variation in marks was explained by satisfaction (or vice versa, since the computed value was greater than the fisher statistic for contingency table rows and columns, at the alpha 0.01 significance level, n1=22, n2=12, n3=36, n4=11). This suggests the
course design and delivery methodology is working. However, no testing was done to isolate whether the design or instructor methods singularly accounted for the variance. Nevertheless qualitative feedback […] from all stakeholders confirms goal-based instruction and course design were both key factors.

1.7. Thesis Document Outline
This Chapter 1 has explained the overview, significance, and research challenges associated with developing a professional learning model to advance the PM practice. It has also summarized the 4.5 years of preliminary thesis research, including the supportive findings of several action science online course pilots.

Chapter 2 narrates an extensive critical literature review, focused on relevant and rival educational psychology theory, from broad to specific professional learning principles, and concluding with rationalized models. Chapter 3 describes the methodology for conducting this research and a quasi-experiment to test the model, which is followed by Chapter 4, the objective results. Chapter 5 interprets the experiment results as they apply to the professional learning model, along with their implications, and it closes with a proposal for continued research.

This document is accompanied by the references, a glossary, and appendices of supporting evidence. The research ethics consent is in Appendix 1, the survey instrument is attached in Appendix 2, while the experimental data is included in Appendix 3.

The ensuing diagram in Figure 1.2 summarizes the thesis research epistemology. It illustrates how the key research facets contribute to the rationalized professional learning goal model, which will be explored in much more detail within later chapters. This diagram is a meta-theoretical concept map that highlights the major principles and subject areas explored in the 4.5 year effort. The concept map will also be used in the upcoming Chapter 2 to illustrate and contrast how this professional learning goal model compares to contemporary major theories and empirical studies in the literature.
Figure 1.2: Thesis Research Meta-Theoretical Framework
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1.8. Chapter Summary

This chapter has introduced the thesis research questions, the rationale for the study, and the hypothesis that applying a professional online learning approach will improve PM course performance and satisfaction levels.

The pre-thesis research was summarized, listing key outcomes and published research. A critical pre-thesis input to this research that was discussed was the online teaching pilots, which served as a proof-of-concept to build the professional online learning models (explained in Chapter 2) that will be augmented and tested in this thesis.

Examples of the pre-thesis research and pilots, the model-building course design, as well as syllabi from the courses designed/delivered in the thesis research, are available from Ken.Strang@excite.com. The research ethics forms are attached as Appendix 1, the course survey instrument is located in Appendix 2, and the actual data gathered from the course is listed in Appendix 3.

Finally, the outline of the thesis was presented, followed by a concept framework showing how the epistemology is organized and integrated into this research. The next chapter will consist of a literature review and the theory building of the professional learning models.
2. LITERATURE REVIEW AND THEORY BUILDING

2.1. Chapter Introduction

Whereas Chapter 1 essentially explained the “why” of the thesis, this chapter explores the “how and what” in terms of the relevant contemporary and fundamental adult learning concepts. The literature review concentrates on identifying specific principles that support a professional learning approach for online course design and delivery. Two knowledge constructs are presented to guide the theoretical discovery. Focus is placed on the relevant fundamental principles grounded in traditional educational psychology, not on contemporary e-learning practices, since as pointed out in Chapter 1, there are few conclusive empirical studies of online design and delivery methodologies.

First the gap in current online professional learning literature is located then the research philosophy is presented. Recent literature is critically analyzed to identify professional online learning findings and rival theories. A brief historical exploration in the first part of the chapter summarizes the main schools of thought from the behaviorism movement, humanistic domain, cognitive development ideology, and the constructivist paradigm. This examination is aided by three diagrams (Figure 2.1, Figure 2.2, and Figure 2.3). A synopsis of the relevant principles from all ideologies is conveyed through four tables, followed by integrative discussions of formal adult-centered learning theories and contemporary practices. Subsequent sections illustrate how these principles are implemented in professional educational design and delivery approaches (theory frameworks, learning context designs, and systemic methodologies).

Five important models are built in this chapter. The first shows the interaction of key learning principles (Figure 2.4: Systemic Model of Self-Regulation, Self-Efficacy, Goal-Setting), the second proposes an instructional process (Figure 2.6: Professional Learning Instruction Process Design Systemic Model), the third is a context design idea (Figure 2.7: Professional Learning Context Design Systemic Model), and the forth synthesizes all the ‘applied’ principles (Figure 2.8: Synthesized Professional Learning Principles Model). The chapter closes with the fifth, an experimental factor model for later testing (Figure 2.9: Professional Learning Goal Experimental Factor Model).
2.2. The Gap in Current Professional Learning Practice

The challenge in contemporary adult learning research is to clearly show value and substance by articulating a credible idea as an innovation or extension to existing theory. Building a new or better mousetrap is difficult given the substantial high-quality literary competition empowered by the Internet’s virtual knowledge pathways. As pointed out, research indicates current practices are not parsimonious on the best model to help professionals continuously and effectively learn online, likely due to the fact the virtual design and delivery infrastructure of the Internet is just beginning its life cycle. Nevertheless the adult-centered learning literature describes credible online approaches.

Contemporary research illustrates an increased focus on the adult learner as the key stakeholder (Grandzol 2004; McAlpine 2004; Chapman 2005; Crick and Wilson 2005; Kolb and Kolb 2005; Maclellan 2005; Muir 2005; Waight and Stewart 2005b). In particular there is growing importance associated with surveying adult learner needs prior to design and delivery, and secondly researchers assign a higher priority of adapting technology to support pedagogy, not vice versa, for online learning (Arbaugh 2005b; DiMaria-Ghalili, Ostrow and Rodney 2005; Kirkpatrick 2005; Moon, Birchall, Williams et al. 2005; Tynjala and Hakkinen 2005). Professionals and managers need more ‘holistic . . . client-centered, learning-based values and principles” (Briggs 2004, p. 9). Even rival or statistically non-significant empirical studies in the online adult-centered learning literature call for more research in the domain (such as course content: Arbaugh 2005a; Burton, Bamberry and Harris-Boundy 2005; Rungtusanatham, Ellram, Sieferd and Salik 2004; Singh and Pan 2004; teacher self-efficacy: Tuovinen and Paas 2004; VanOord and DenBrok 2004; and somewhat in: Arbaugh 2001).

The comprehensive adult-centered learning literature in academic and business contexts promotes the fundamental principles of motivation, meta-learning, self-regulation, critical thinking, self-schemas, social learning, and self-efficacy (see books such as: Apps 1994; Meredith and Mantel 1995; Argyris and Schön 1996; Honebein 1996; Taylor 1998; Senge, Kleiner, Roberts, Ross and Smith 1999; Kerzner 2000; Mezirow 2000; Anderson and Krathwohl 2001; Mayer 2003; Duffy and Kirkley 2004; Ormond
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2004; Schunk 2004). The underlying principles are derived from the humanistic, cognitive, and constructivist educational psychology and social science meta-theories.

Current applied online adult-centered studies tend to focus on either specific principles (such as subject matter, problem-based social learning in discussion forums, self-efficacy, self-regulation, etc.), or they take a holistic meta-theoretical approach (such as design-to-delivery methodologies, grounded in multiple constructivist-humanistic principles). The latter ontology is where this thesis is positioned, yet it is acknowledged the specific-principle research is valuable because smaller scope facilitates empirical analysis, and it is argued here seasoned educators indirectly apply constructivist and humanistic principles anyway (but those factors are often not controlled in paired-tests).

2.2.1. Comprehensive Meta-Theoretical Adult-Learning Approaches

Beyond the comprehensive books cited earlier on adult-centered educational psychology theory and practice, new models have emerged in the literature. Several relevant studies are aligned with the same humanistic-constructivist principles in this thesis (see: McAlpine 2004; Roussev and Rousseva 2004; Rungtusanatham, Ellram, Sieferd et al. 2004; Stonebraker and Hazeltine 2004; Moon, Birchall, Williams et al. 2005; Tynjala and Hakkinen 2005; Waight and Stewart 2005a).

For example, organizational learning (e.g. knowledge creation/sharing, communities of practice), sociocultural theories (e.g. learning styles, social-psychology, situated learning), and cognitive theories (problem-based, conceptual, meta-learning), have been blended into a theoretical model for professional e-learning (Tynjala and Hakkinen 2005). Their research is exemplary and representative of the recent trend to integrate humanistic and constructivist adult-centered principles. Their model (summarized in: Tynjala and Hakkinen 2005, Table 1, p. 331) integrates this ‘thesis vision’ principles of: professional apprenticeship mentoring (Collins, Brown and Newman 1989), organizational triple-loop contextual learning (Lee, Green and Brennan 2000; Yeo 2002; Elkjaer 2003; Illeris 2003), as well as knowledge creation/communities of practice (Wenger 1998; Nonaka, Toyama and Konno 2001; Wiig 2001). Additionally
their approach facilitates cognitive development (Scandura 1970; Flavell 1976; Sweller 1988), and constructivism/social learning (Bandura 1986; Bruner 1990; Bandura 1997). They condense several meta-theoretical concepts into a short concise article. Two significant concepts they develop are “learning goals” for motivation, and “scaffolding” to support cognitive development (pp. 323-327), which cover both ‘domains’ of the humanistic-constructivist continuum. However, their study lacks empirical evidence.

Another adult-centered online study measured humanistic-constructivist factors of the work context (perceived job relevance, sense of cohesiveness, task interaction opportunity, and social interactions) as part of a virtual professional course (Stonebraker and Hazeltine 2004, pp. 216-218). In relation to the thesis principles, their study found statistical support for a learner-centered design that emphasized the contextual factors mentioned above. What is interesting is all factors contributed to increased learner satisfaction, specifically 32.3% for level of learning satisfaction, 10.2% for job relevance, and 3.5% as sense of cohesiveness (Stonebraker and Hazeltine 2004, p. 220). This suggests humanistic principles work in organization training contexts.

Moon and colleagues (Moon, Birchall, Williams et al. 2005) build on the excellent empirical work of several of the co-authors (mainly: Vrasidas and Zembylas 2004) to create and test a humanistic-constructivist model for designing and delivering professional adult-centered online learning. The earlier empirical study of two e-learning professional development projects consisted of a framework applying principles of: “individual and social constructivism, situated and distributed cognition, local and non-local communities of practice” (Vrasidas and Zembylas 2004, p. 329) and naturally that earlier fieldwork seems to influence their current model. That earlier study concluded "using technology by itself does not support professional development; however, using technology in ways that are consistent with constructivist learning, and recognizing that online professional communities of practice can contribute to professional growth…” (Vrasidas and Zembylas 2004, p. 333). Their recent work emphasizes an adult-centered stakeholder needs-analysis (focus group) course design approach, and they incorporate many of the humanistic-constructivist principles
advocated here. For instance, they talk about applying learning ‘chunks’, ‘self-
reflection’, problem-based ‘cases’, and social learning theory (see Table I, p. 372, and
Table II, p. 378 in: Moon, Birchall, Williams et al. 2005). Their case study using six
European businesses “clearly demonstrated that it was the manner in which technology
was used to deliver e-learning to students which was the important factor in its
success...” (p. 373). This supports the thesis argument that the humanistic-constructivist
design and delivery approaches can improve professional online learning.

The formal adult-centered theory of andragogy is discussed later in the thesis, and while
there are many good examples of its current application for online professional learning
design and delivery, one theoretical study (Rungtusanatham, Ellram, Sieferd et al. 2004)
produced a good model that is aligned with the principles documented in this thesis.
Their research is theory-grounded, arguing for a learner-as-a stakeholder focus in online
design and delivery. They point out the weakness in current practice is that ‘two
approaches tend to prevail in academic environments – one that is heavily faculty
driven…and one which is driven by a design team of faculty and other experts...’
(Rungtusanatham, Ellram, Sieferd et al. 2004, pp. 103-104), so they espouse a learner-
centered philosophy. The humanistic-constructivist model they create employs all of the
andragogical principles endorsed in this thesis, but their emphasis is on “deeper
conceptual learning” (p. 106), as well as self-regulation and self-reflection (“learning
pace control …double-loop learning”, p. 106). They also strongly promote problem-
based learning techniques and content flexibility. There are two main differences in
their approach as contrasted to this thesis (beyond the use of a proprietary design
methodology, and they have not validated their models). First (as will be discussed
later), this thesis develops a constructivist-oriented professional learning framework,
informed in part by three mainstream design systems: ARCS (Keller 1983), Nine Event
Instructional Approach (Gagné 1985; Gagné, Briggs and Wager 1992), as well as being
influenced by Anchored Instructional Theory (Bransford 1990). This thesis also differs
by placing higher priority on learner motivation facilitated by goal-setting, and as well
as volition through course delivery flexibility. The common elements also supported
here are self-regulation, self-efficacy, self-schema, and reflective learning. Their future
empirical test of the (Rungtusanatham, Ellram, Sieferd et al. 2004) model with managers will be interesting and comparable here.

One of the most convincing recent empirical studies developing and applying a professional adult-centered online learning design and delivery model is the “active learning through modeling” (Roussev and Rousseva 2004). Their approach is very analogous to this thesis in that they apply traditional constructivist principles from broad meta-theories. They also integrate adult-centered “active learning” and “cognitive skill development” techniques (pp. 122-123), and use a rigorous paired-treatment experiment (with contextual controls for instructor, content, and participants) to substantiate their model. The theoretical underpinnings of the their approach leverages the principles of “metaphor, abstraction, modeling, Bloom’s classification of cognitive skills, and active learning” (p. 139). As compared to this thesis, Bloom’s taxonomy is more traditional (behavioristic) as contrasted with the humanistic-constructivist approaches. The traditional Bloom taxonomy they employ has the three educational psychology domains of cognitive, psychomotor, and affective; yet it has been advanced by several researchers (Gronlund 1970; Anderson and Krathwohl 2001). Furthermore, the Bloom taxonomy is now encompassed within formal instructional design models (by Gagné, Merrill, and Mager as discussed later), and is supplemented by the contemporary Structure of the Observed Learning Outcome (Biggs 1995). They develop their model and apply it for online software programming courses while the professional learning approach is targeted at MBA and PMs. Albeit the content and stakeholders differ, from experience there is an overlap of these disciplines in the field since many contemporary projects involve some aspect of technology and the teams usually include business as well as programming resources. Their findings were statistically significant, being the "teaching method is the only factor with predictive power with respect to programming skills" (Roussev and Rousseva 2004, p. 139). Furthermore they used rigorous controls (students showed normalcy with similar SAT scores, etc.). This thesis is therefore in part a theoretical replication of some of their concepts. Like the other studies cited here, they position the rationale for their research as a need to publish more empirically proven models for online adult-centered course design and delivery.
An interesting theoretical model for online professional learning was developed (and later tested) by integrating the four principles of “leadership, learning culture, technology infrastructure, and finance” (Waight and Stewart 2005a, p. 338), with an emphasis on the adult learner as the key stakeholder. The study was relevant to this thesis because it focused on continuous professional learning in the business sector, and emphasized leadership as well as “deutero learning” (p. 338). Deutero learning is an important reflective-learning “triple-loop” principle (Senge, Kleiner, Roberts et al. 1999) highlighted in this chapter and also modeled in previous research (Strang 2003).

Their subsequent multiyear empirical case study of four Fortune 500 USA-based companies (in different industries: retail, IT, energy, insurance) revealed support for their model. They found “e-learning teams are complying with all factors…” (Waight and Stewart 2005b, p. 414). Mainly what is significant here is they observed humanistic-constructivist adult-centered learning design and delivery principles in the training programs at all four companies. They counted high occurrences of “needs analysis, learner analysis, learning culture, learning theories, creativity, engagement, and learning” (Table 1, p. 414). Another finding was "developing the technology-related knowledge, skills, and attitudes can be a major prerequisite for performance and self-efficacy among adult learners" (Waight and Stewart 2005a, p. 339), implying self-schema and self-efficacy. The design and delivery approaches developed and tested in the thesis are meta-theoretical and integrative, as compared to team learning principles.

Self-efficacy principles were proven significant for both online as well as face-to-face design and delivery in a comparable study of 50 adult learning professionals (Francescatoa, Porcellia, Mebanea, Cuddettaa, Klobasb and Renzia 2006). Their sample frame was equally small in relation to this thesis (as will be discussed in Chapter 3, n=48), so their study faces the same size limitations as here. Also their goal was to compare online versus face-to-face methods, whereas the aim here is to prove adult-centered humanistic factors are significant, regardless of course subject matter, delivery mode context or instructor. Nevertheless they were successful and were able to substantiate their hypotheses. Their study strongly controlled for contextual factors
(instructor, course design, subject matter, organizational culture/infrastructure). The finding was that “computers can be an effective enabler, not only of independent learning, but also of collaborative learning” with the implication “computer-supported collaborative learning environments are as efficient as collaborative learning in face-to-face seminars in developing social presence and increasing professional competencies and self-efficacy” (Francescatoa, Porcellia, Mebanea et al. 2006, p. 163).

Zhang (2005) reported a large empirical study of six cases applying humanistic-constructivist, adult-centered learning design and delivery experiences (n=5019 from Hong Kong, mainland China, and United States, p. 83). The key factors were cognitive development, modes of thinking, career interests, learning approaches, thinking styles, and personality traits. In that multicultural study, results indicated “in all three cultures, students who rated themselves higher on the ability scales tended to score significantly higher on the individual-difference variable scales that denote positive values, such as higher cognitive-developmental levels and creativity-generating thinking styles” (p. 67). The key implication was “educators may facilitate student development in the various domains by boosting students’ self-evaluations of their own abilities” (p. 84). The study illustrated the importance of self-efficacy (the author described it as self-rated ability).

This thesis strives to achieve similar empirical results for PM learning by applying more androgogical motivation but less emphasis on individual thinking styles and personality. This rival approach is analyzed later in the discussion of the CAL formal theory (p. 72).

Other recent literature aligned with the principles advocated in this thesis take a more theoretical exploration at the organizational stakeholder level of analysis, as an approach for professional online learning design and delivery. One study of professional adult students encourages the professor to employ conceptual learning principles during the instructional design and delivery phases by using a “mental map to overlay decisions about instructional strategies” (McAlpine 2004, p. 119) for creating an online education model. This adult-centered design and delivery approach recommends aligning underlying model theories of learning and applying adult-centered research in higher education directed to supporting learning. “The model provides a framework that
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highlights the critical role of practice, structure and formative feedback in the learner’s preparation for formal summative assessment and is proposed as a design tool and a chronology for instruction and for learning” (p. 119). Her concept seems to employ a triple-loop (Senge, Kleiner, Roberts et al. 1999) organizational learning tactic to help “unfreeze faulty learning approaches associated with previous courses/universities...” (p. 130). Feedback is a common element also endorsed in the thesis model approaches.

2.2.2. Studies of Specific Theories and Principles in Adult-Learning

Specific principles such as problem based learning (PBL) were proven significant for online professional education in a study (Webb, Gill and Poe 2005) that used the case method pedagogy (n=180, class size=20 to 30, length=10 to 15 weeks, experimental duration=20 months). Their experiment was rigorous (good context control through treatments), for testing outcomes such as self-efficacy, motivation, interest, cognition, conceptual learning, critical thinking, social participation, and performance. The finding was "students not only appear to do as well as in the traditional classroom, but the data suggests that students in the online environment may even perform better at multiple levels of learning outcomes..." (p. 247). By ‘multiple levels” they refer to the numerous outcome types just mentioned, such as individual as well as group reflective learning, factual (rote memorization) as well as conceptual learning, etc. Their method applies a powerful ‘perspectives triangulation’ to observe multiple cause/effect levels from stakeholders (although beyond the practical scope of this thesis, I will apply that in future research). Albeit their benchmark was rooted in pre-online era literature (early 1990's), I feel PBL theory is sound, and with the addition of the humanistic elements, their model looks promising. As compared to my preliminary tests, an advantage to their assessment structure is the specific measurement of perceived learner motivation.

There are many additional empirical studies proving the effectiveness of specific principles advocated in this thesis for online adult-centered learning design and delivery. Problem-based learning has almost always proven to be effective in just about any reasonable adult-learning context, as evidenced by studies similar to this thesis (for examples see: Gilding and Martino 2001; Duffy and Kirkley 2004; Smith 2005). Studies
have shown support for conceptual learning, cognitive load theory, and meta-cognition principles employed in adult-centered professional learning (see: Tuovinen and Paas 2004; Maclellan 2005; Murphy and Tyler 2005).

An important focus in this thesis is self-regulation and goal setting, which have also received positive significant findings for adult-centered learning in recent studies (Newton and Ellis 2005; Sizoo, Agrusa and Iskat 2005; Zibit 2005). Self-efficacy is also frequently studied (and proven significant) as a key adult-centered learning factor (such as in: Zhang 2005; Anderson, Hattie and Hamilton 2005; Yang 2004b; and somewhat in: DeShields, Kara and Kaynak 2005; Thompson and Perry 2005). Social learning and communities of practice have also been singularly studied in conjunction with effective adult-centered online learning practices (such as in: Volet and Wosnitza 2004; Edgington 2005).

Adult-centered learning styles and personality factors have also been studied in the recent literature with statistically significant predictors identified (for example see: Cybinski and Selvanathan 2005; Kolb and Kolb 2005; Mo, Mok, Ma, Yuk, Liu and So 2005; Schniederjans and Kim 2005). Learner style adaptability is perhaps the weakest element in the thesis principles in that there is no focus here on customizing the design and delivery principles of self-efficacy, motivation, self-regulation, self-schema, and meta-learning for individual personalities. Some flexibility is available in the professional learning model advocated here (such as individual or group work), but the approach delegates the learning style assessment and adjustment to the learner (as discussed later, it is not part of the model). Although this thesis argues for a holistic generalized approach, a rival meta-theoretical model addressing individual learning styles was discussed earlier (Zhang 2005), and that was proven statistically significant.

Nevertheless, empirical studies tend to suggest that while specific attributes of personalities and learning styles can be identified as predictors of performance with given instructional methods, there seems to be a normative generalization that can be
applied and assumed, which is built into the group-level approach advocated here (for example learning competency generalizations see: Owens 2005; Quek 2005). This is a pragmatic economies-of-scale limitation upheld in the thesis. It would not be practical to use the models and approaches developed in this thesis to customize professional learning for every single adult – some generalization of the professional learning needs and norms is necessary (a good example is promoting adult learning autonomy and persistency: Ponton, Derrick and Carr 2005). An alternative would be to provide the learner with materials and resources for them to assess and accommodate their style, or to design and implement purely self-directed learning theories (discussed below).

There are good rival adult-centered professional online learning theories, with the main one being self-directed learning (Hiemstra and Brockett 1994; Ellinger 2004; Min-Huei Chien 2004; Ponton, Derrick and Carr 2005). Furthermore several positive studies advocate ‘personalized, student-centered instruction that takes differences in prior knowledge and skills into account’ (Nadolski, Kirschner and Merrienboer 2005, p. 235). Akin to the economies-of-scale caveat asserted in the paragraph above, this thesis instead tries to make generalizations about professional adult learner needs, in a sense, applying self-schema development, efficacy building and andragogical motivation to all participants. Rival theories such as these could be explored in future research.

Some literature contains highly systematic adult-centered learning methodologies, similar to the Instructional Systems Design (ISD) model (Dick and Carey 1996). An interesting approach which compares to previous research was the combination of knowledge creation and scaffolding, integrated with traditional ISD (reported in: Strang 2004b; Strang 2004a). Similar alternative research contains cases focused on scaffolding and subject matter content, customized for online professional-discipline learning design and delivery (Byers 2005; and somewhat similar is: Arbaugh 2005a). The general conclusion from these ‘alternative approaches’ is that better knowledge structures facilitate adult learning but factors relating to the instructional method were likely more significant (but were not controlled for or assessed). Therefore the common
link in both relevant and alternative current literature is a learner-centered humanistic emphasis in course context design and during delivery.

A phenomenon that may escape many forward-looking model-building approaches (such as the techniques applied in this thesis) is that changing things may not necessarily show a significant effect but reversing processes could be catastrophic. The consistency of scaffolding, andragogical motivation, and self-regulation are proven significant as specific principles in several studies. For example in one university online adult learning study similar to this thesis research, "students that received traditional instruction first and then received lectures with PowerPoint did not experience a change in classroom motivation… However, students who were initially taught with PowerPoint and then received traditional lectures [they] became less motivated…” (Susskind 2005, p. 209). This emphasizes a negative aspect of triple-loop learning in that reducing scaffolding (reverting to traditional methods) can be problematic.

2.2.3. Status of Online Professional Adult-Centered Learning

Despite the interesting research cited in this chapter (and as Chapter 1 asserted), current literature does not offer a clear applied model of adult-centered humanistic-constructivistic principles for online professional learning (Beaudoin 2002; Gallini and Barron 2002; Johnson and Aragon 2003; Petress 2003; Duffy and Kirkley 2004; Maclellan 2005; Muir 2005; Peters 2005; Tynjala and Hakkinen 2005).

"What has adult education sent back in terms of theory? Not much” (Chapman 2005, p. 310). Comparable empirical business studies confirm ‘very little is known about how the adult learner in e-learning is valued within corporate settings” (Waight and Stewart 2005a, p. 337). ‘What changes rapidly is the technology, not the basic processes of learning. It is rather worrying that e-learning is sometimes interpreted in a narrow sense as referring to process of delivering digital information and study materials to people through the electronic media’(Tynjala and Hakkinen 2005, pp. 318-319). Two additional representative claims of the theoretical gaps are expressed by these writers.
Unfortunately, the theoretical justification for the pedagogy of distance education has not kept up with the growth in its practice...What applies to one particular technical content area may not apply to another, more humanistic, body of subject matter. What applies to one mode of distance learning (e.g., synchronous chat) may not generalize to other modes (e.g., asynchronous discussions). As a consequence, research is forced to proceed on a case-by-case basis. (Webb, Gill and Poe 2005, pp. 223-224).

Although the topic of adult learning has been at the central stage of the adult education field since its inception, and many theories and models have been constructed, no single conceptual framework exists that can be used to explain the complex phenomena of adult learning. No unifying theory of learning has emerged because of the complexity and diversity of the adult learning process. (Yang 2004a, p. 241).

The most relevant humanistic-constructivist models in the aforementioned literature did not contain sufficient factor models and/or experimental design description to fully replicate the tests, and often they did not critically review rival theories. Rarely did any of the studies contain a construct summarizing the underlying key principles or formal theories (as well as how they were applied), and only two of the recent online learning studies provided a factorial model showing the cause/effect relationship of their hypotheses. As a result of this assertion, the thesis refines the literature exploration by reviewing fundamental educational psychology principles and theories that will be leveraged to build models for online professional learning design and delivery. Following that, an experimental factor model will be created for subsequent testing.

2.3. Philosophical Learning Visions, Perspectives and Frameworks

The starting point of the thesis was a conceptualization of the relevant adult learner-centered educational psychology theories, designed from previous research as a ‘stakeholder-grounded’ cognitive schema to organize the fundamental epistemology
from all the schools of thought and disciplines. This is shown in Figure 2.1 (Strang 2004b; Strang 2004a, p. 14; Strang 2005f), and is described later.

![Diagram of Professional Learning Theories]

**Figure 2.1: Knowledge-Based Macro-View of Professional Learning Theories**

Later sections of this chapter will illustrate traditional educational psychology theory is very comprehensive with underlying principles that date back hundreds of years. Adult-centered learning literature is growing, with validated models emerging in the 1970-1990's, followed by the application of the Internet (and other technology) to online education, itself relatively new and surfacing during the 1994-present time frame.

My early experience with online adult education was using cable-TV (and teleconferencing for interaction) to broadcast management and social science courses to adults in the community (which I also taught in parallel using face-to-face modes, during 1997-2001). This was part of the New Brunswick Community College and TeleEducation New Brunswick (Canada) distance learning programs (some of which was reported in: Russell 2003a; Russell 2003b; Strang 2004b). Colleagues and I subsequently practiced adult learning to world-wide business professionals in face-to-face and online (Internet) modes at the Project Management Institute (PMI), Life Office Management Association (LOMA), and at international university adult education.
programs (Gale 1998; Chappidi, Patel and Lawhead 2003; Strang 2003; McLaren 2004; Strang 2004a; Edgington 2005; Owens 2005; Strang 2005d; Zibit 2005).

Those of us in our small research community practicing online methods of adult-centered learning found ourselves on the ‘leading edge’ in several theoretical ontologies. The critical reflective lesson we learned from early research is to base design and instructional strategy on learning-centered principles, while avoiding the temptation to overlook educational philosophy and theory to favor technology or bureaucratic constraints. These experiences form the basis to structure the line of inquiry in this thesis towards finding better humanistic adult-centered approaches. The thesis takes a transformative perspective in reviewing fundamental educational psychology principles to emphasize (and adapt) humanistic-oriented approaches for professional (adult-centered) learning. The key emphasis is on learner motivation and flexible design and delivery methodologies. This extends existing research cited earlier.

2.3.1. Benefits of Knowledge-Anchored Professional Learning Research

The reason this knowledge-anchored stakeholder orientation was deemed critical to apply as the archetype to represent the epistemology, is based on a pragmatic view to this research, being that it must be understandable and usable by those very stakeholders who connect the theory with the actual practice context. The key stakeholders in this instance are propositioned to be the student, the professor/mentor, and the organization (company, university, etc.). These professional stakeholders must be able to understand and use this information. Since this theory is ultimately intended to be used by educators, project mentors, team managers/members, and other researchers, the idea is to organize the thesis epistemology as a knowledge creation and sharing structure.

In this thesis, stakeholders, by their inclusion, delimit the scope of the knowledge framework, while metaphorically contributing to, sharing, and interacting with, the learning epistemology at the center. At the outer boundaries, a multitude of traditional macro-environmental factors impact the key stakeholders and theory (such as social, political, legal, economic, competition, individual competencies, etc.), to mirror reality.
This model has an interesting inflection for the organization as a key stakeholder. From a macro environmental perspective, economic and social drivers in the academic field emphasize a demand for higher education design and delivery approaches that allow products to be built and maintained efficiently, offered globally/remotely, and to multiple cultures (DuBrin 2004; Strang 2005f). Subscribing to these drivers requires economies-of-scale thinking from the production view of the organization (with subsequent competitive prices and reduced material costs/delays), efficiency from the professional standpoint (minimal but high-quality involvement and maintenance for maximum learner performance/satisfaction), as well as effectiveness from the client perspective (quality, price, flexibility). The relevance of this on the organization is an increasing demand for efficient and effective, ‘anywhere, anytime’ (online) continuous professional learning (Maclellan 2005; Murphy and Tyler 2005; Sizoo, Agrusa and Iskat 2005; Strang 2005c; Tynjala and Hakkinen 2005; Waight and Stewart 2005a; Webb, Gill and Poe 2005; Francescatoa, Porcellia, Mebanea et al. 2006).

Good alternative approaches to using the adult-centered epistemological knowledge structures and methodologies suggested here can be found in several online higher education studies, such as: (Dunbar 2004; Leigh and Spindler 2004; Maxwell, McConaghy and Ninnes 2004; Naik and Ragothaman 2004; Singh and Pan 2004; Arbaugh 2005b; Combe 2005) – each of these articles have unique perspectives representative of possibly effective rival theories to this thesis ideology.

2.3.2. Systemic Stakeholder View of Learning Approaches

There is another perspective to the stakeholder view of the epistemology reflecting the increasing value emphasis on flexible learning referred above – this can be described as a systemic rationalization of the learning design and delivery service. The previous diagram (Figure 2.1) represents a knowledge framework for theory articulation, creation and sharing, at least for this research, while the next figure will offer a ‘contextual systems perspective’ of how an improved learning model might operate in a business environment (as compared with traditional higher education business-as-usual style).
This ‘contextual stakeholder view’ in Figure 2.2 is a transformative perspective (Mezirow 1991) of Figure 2.1 created from previous research by using critical reflection and stakeholder feedback to challenge assumptions in order to achieve a better understanding of the adult learning context from all angles. This is achieved by looking beyond just instructors, or university administration/management, or technology, or business, or the adult learning – instead, all of these stakeholders are encompassed.

![Diagram of Holistic stakeholder perspective applied to this research](image)

**Figure 2.2: Systemic Stakeholder View of Professional Learning Context**

Figure 2.2 (Strang 2004b, p. 13; Strang 2004a, p. 2; Strang 2005c; TARGET is from: Schunk 2002) is an example of a ‘holistic stakeholder learning paradigm’ applied to this research. In this diagram, a perceived contemporary view of learning design/delivery (on the left) is conceptually contrasted to the author’s open systems / stakeholder approach. A fourth stakeholder is shown to represent the external public, but is not critical to this instance of the model. This second diagram is constructed from a holistic application of diverse social and management science theories. It shows how the key stakeholders in the ‘total learning context’ might interact from a systemic point of view. One benefit of models such as these is they prompt us researchers to broaden our
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theoretical and philosophical landscapes by accounting for multiple perspectives, cultures, contextual drivers, and social-system interactions.

At a macro level, the contextual paradigm implied by this model (also described as situated learning, social cognition and distributed learning in the literature) argues that instruction, thinking, and learning are influenced by the physical and social environment (Mayer 2003; Ormond 2004; Schunk 2004), as well as by the professional learner and instructor (Illeris 2003; Kivinen and Ristela 2003), which therefore implies pedagogy should benefit from a flexible stakeholder-guided approach to course design and delivery.

At the micro level of analysis, the key difference from the contemporary view, as proposed by this stakeholder learning context, is that the focus here is on the integration of several instructional behaviors to understand, support, and motivate the learner, which is also the approach taken by comparable empirical research (Chapman 2005; Combe 2005; Crick and Wilson 2005; Lemak, Shin, Reed and Montgomery 2005; Moon, Birchall, Williams et al. 2005; Waight and Stewart 2005b; Webb, Gill and Poe 2005). Preliminary research and literature confirms learning and instructor self-efficacy are strengthened by a supportive organizational environment, providing collective efficacy (Anderson, Hattie and Hamilton 2005; Burton, Bamberry and Harris-Boundy 2005; Neal and Miller 2005; Susskind 2005; Waight and Stewart 2005a). Furthermore, a reliable technological infrastructure adds stability and efficacy to all the stakeholders in the contextual model.

The deeper meaning of this model comes from management science theory. On the left is the characterization of contemporary learning environments as mechanistic (highly formal, rules and policies based, program driven objectives, focused on efficient/effective economic profitability and resource utilization), with the open system contextual design being diametrically portrayed as organic and adaptive, on the right side of the diagram. A stakeholder focused advantage of improved professional learning and delivery approaches (derived from this model on the right) which ultimately benefits all key constituents, is more critical reflection and professional development
time allocated to advance theory and integrate it into courses for continuous improvement and evolution. The contextual stakeholder model is propositioned to be important because it encompasses the reality of the broader learning environment. However, a systemic perspective is too broad a scope to use for achieving the quasi-experiments and realizing the thesis goals but it serves purpose to introduce this model here to encourage a stakeholder needs-driven philosophy of the learning context.

2.3.3. Reflective Research Orientations
A broad-minded philosophical perspective is taken with this research (the details are discussed in the methodology – Chapter 3). The purpose of applying a rationalistic-to-positivist continuum in this thesis is to subscribe to the multiple stakeholder views of reality. Accordingly, this research focuses on the professional stakeholder aspect of learning goal theory, as influenced by both rationalism and functionalism philosophies, founded in humanistic and constructivist psychology, as well as being grounded upon goal-setting and contextual development learning theories. Much of the work is driven by actual experience, in particular it is informed by previous research and action learning science involving field pilots (Strang 2004b; Strang 2004a; Strang 2005a; 2005c; 2005f). With that said, the remaining portion of this chapter will highlight many of the subjects within the knowledge framework of Figure 2.1, while keeping the focus on the ‘learner’ as a key stakeholder, and on the ‘learning goal motivation’, as a core competency for an improved professional learning design (details are in: Strang 2004b; Strang 2004a).

2.4. Meta-Theoretical Learning Ideologies
The professional learning goal theory\textsuperscript{3} definition of the previous subsection establishes scope to guide a brief recourse through the historical and contemporary educational psychology literature for exploring relevant (key) principles influencing this research.

2.4.1. Learning Theory Definitions
There is no single rendition of learning theory that is universally accredited by the community of theorists, researchers, and practitioners (Shuell 1990; Mayer 2003). The

\textsuperscript{3} The terms ‘learning goal method’, ‘learning goal theory’, and ‘professional learning approach’ are used in this thesis to mean a proposed context design and delivery model.
generic meaning of learning from the dictionary describes it as an “act, process, or experience of gaining knowledge or skill; in psychology, behavioral modification especially through experience or conditioning” (Houghton-Mifflin 1994). A credible behaviorist definition from the learner stakeholder perspective is: “an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience” (Schunk 2004, p. 2). Although this research is focused on constructivism, the behaviorism view is important to state because organizational stakeholders seek change for their PMs and teams.

2.4.2. **Learning Theory Historical Foundations**

A broad-minded dualistic interpretation of learning from an educational psychology and cognitive standpoint is: “psychologies of subject matter: a focus on developing, learning, teaching, and thinking within the context of specific subject areas; cognitive process instruction: a focus on fostering cognitive processing that leads to meaningful learning” (Mayer 2003, p. 24). In particular, his reference to “fostering cognitive processing” and “meaningful learning” represents the ideologies underlying many of the principles within this research. The above two definitions represent the customary ‘real learning’ definitions in the literature which range from behavior and performance change to cognitive advancement and generative learning (Roussev and Rousseva 2004; Rungtusanatham, Ellram, Sieferd et al. 2004; Tynjala and Hakkinen 2005; Waight and Stewart 2005a).

As a brief historical introduction to the key theoretical ideologies underlying this work, educational psychology is typically classified as three to five philosophical ‘movements’ (which roughly follow the same chronicled progression). These are the psychoanalytic development (biological and classical conditioning), behaviorism (operant and attributional conditioning), constructivism (cognitive development and conceptualization), and social development (contextual cognitive development and adaptation). Of course there are many alternative meta-paradigms and interpretations in the literature. There are also many principles that are fundamental and common to all these classifications (such as motivation, perception, memory functioning).
Behaviorism has been well-documented in psychology, constructivism has been explored within the domains of cognitive development and knowledge creation, while it could be argued that social cognitive development has its epistemological roots spread through philosophy, anthropology, sociology, psychology, and even management science. The following sections group the key educational psychology principles into the four macro-level dimensions discussed above. These basic principles are important for understanding the holistic and multidisciplinary models the thesis develops, which I believe must include both macro level (approaches) and micro level (root definitions).

2.4.3. Integration of Educational Psychology Meta-theories

Ancient philosophical principles such as justified perception, rationalism and empiricism, have impacted modern educational psychology. These in turn led to recent constructivist views of learning. Constructivism is itself a modern term in educational psychology referring to a cognitive view of knowledge creation whereby individuals learn by ‘constructing’ their own meaning of either concepts and/or events. In constructivism, prior knowledge is “dynamic…explicit and tacit” (Portier and Wagemas 1995, p. 66), or an organic process (Schwen, Kalman, Hara and Kisling 1998). These terms are also derived from knowledge management and they represent contemporary taxonomies to describe what is ‘known’ (beliefs, concepts, events, facts) on a continuum from rationalism to empiricism.

Beliefs from early philosophy fueled the experienced-based empiricist perspectives that led to contemporary psychology’s introspection (observation) methods for research and learning. Introspection also spurned the advent of structuralism, whose foundations emanate from behaviorism (again very empiricist oriented). At the other side of the educational psychology spectrum are reasoning based processes that evolved into the functionalism school of thought and later contributed to the constructivist ideology.

Figure 2.3 is a conceptual meta-theoretical representation developed in previous research (Strang 2004a, p. 6, Strang, 2004b). This can be used as a concept map to guide the ensuing discussion, and to conceptually trace applied principles to the educational psychology origins in literature.
Figure 2.3: Educational Psychology Meta-Theoretical Learning Model

The model positions relevant theories into four quadrants demarcated by two axis suggesting an evolutionary alignment toward structuralism or functionalism (horizontal) along with an empiricism versus rationalism developmental origin (vertical). This conceptualization may assist in understanding but note it is a perceived yet imperfect depiction of theory because there was inadequate space to list all principles (e.g. psycholinguistics, cognitive learning, knowledge creation, perception, personality and learning styles). Also some elements subscribe to multiple schools of thought (across quadrants), and their relative positioning are aesthetic not empirical.

By way of further explanation, Figure 2.3 illustrates an abstract perception of how key principles from philosophy, psychology, sociology, and organizational science influence andragogical motivation (viewed here as the focal enabler for adult learning). The diagram depicts how broad and historical learning theory schools of thought impact at
the outer boundaries (e.g. humanistic perspectives), with significant principles advocated in this thesis summarized as self-schema, self-efficacy, and self-regulation. Goal theory and contextual development are crucial here, and these are captured within the broader theoretical scope of self-regulation and self-schema.

The managerial and social science theories shown do not integrate perfectly as the model visually implies. Instead, fundamental principles tend to influence several domains. Philosophical empiricist views imply behaviorism which in turn associates stimuli (e.g. knowledge, experience and motivation to learn) with responses and consequences, while rationalism advocates cognition along with association to beliefs (an important tenet of goal theory, meta-cognition, self-efficacy, and self-schema). These theoretical views do share the principle that motivation, cognitive develop, and conceptual learning primarily drives adult learning.

The importance of focusing on adult-centered principles is a justified belief gelled from previous experience: ‘motivation and readiness are propositioned here as key tenets for effective project manager learning’, especially ‘intrinsic motivation’ (Strang 2003; Strang 2004a). I strongly identify with the historical importance of learner motivation as a ‘reward cause/effect’ construct, a tribute to the enduring axiom originated by Thorndike (Thorndike 1971). Alternatively, it may be viewed as contentious to assert that effective learning theories emanate from specific ideologies such as behaviorism or social development (or alternatively from all four schools of educational philosophy). It may also be contestable to claim that motivation is one of the most significant determinants of professional learning.

2.5. Synthesis of Professional Learning Principles
The previous section broadly discussed how educational psychology schools of thought inform this research. In this section a synthesis of the relevant principles and theories underlying the professional learning goal vision are explained, as documented from previous thesis research (details available in articles and appendices of: Strang 2002; Hasandedic, Arroyo and Strang 2003; Strang 2003; 2004b; Strang 2004a; Strang 2005a; 2005c; 2005f; 2005d; 2005g; 2005b; 2005e).
Subsections are used to briefly list the key behaviorist, humanistic, cognitivist, and constructivist meta-theories outlined in Figure 2.3. Best practice ideas are offered (where applicable). An integrated summary is presented at the end of this section. The writing is brought back into the theoretical landscape (following the discussion of key principles) to introduce the formal adult-centered theories which inform and compliment the new approach. To use a construction industry analogy, this style attempts to first introduce the architecture blueprint, then the building blocks, followed by the formal standards-driven framing, then customize the final design using best-practices and (hopefully) innovative ideas.

The literature contains good alternatives to this review of (professional) adult-centered learning principles (see e-learning pedagogic themes: Moon, Birchall, Williams et al. 2005, p. 372; Tynjala and Hakkinen 2005). Rival approaches in the literature tend to emphasize techniques for applying specific principles such as problem-based-learning rather than integrate a design and delivery approach informed by meta-theories. The main advantage argued in this thesis is a more holistic, humanistic-oriented approach to emphasize motivational and meta-learning principles that compliments (not replaces) existing course design and delivery methodologies. Furthermore, the models proposed in the thesis clearly identify the applied principles as well as the theoretical position in the overall ideologies.

2.5.1. Behaviorism Movement

Behaviorism is a very ‘real world’ empiricist educational philosophy that links inputs (such as instruction and studying) directly to outcomes (such as process repetition and memory recall). The main tenet in this school of thought is that behaviors are controllable and predictable, and the best way to understand psychological events (like learning) is through observation. The common behaviorist definition of learning cites it as a relatively permanent external and observable change in behavior resulting from experience. Behaviorism literature pragmatists impart that “propositions concerning psychological events are verifiable only to the extent that they are reducible to predictions of behavior under specified environmental conditions” (Estes 1950, p. 94).
Skinner is best known for documenting contemporary behaviorism, whereby he argues that changing behavior in a particular way and learning are essentially synonymous; furthermore, his operant conditioning theorem has been widely applied in educational psychology. Operant conditioning can be achieved through carefully planned and administered ‘reinforcers’ to condition rats, pigeons, dogs, monkeys, and humans into performing any number of behaviors, some of which are very complex (Skinner 1953; 1958). He also developed programmed instruction, which is discussed in a later subsection. Table 2.1 is a synthesis of the relevant principles.

### Table 2.1: Synthesis of Behavioristic Learning Principles from Literature

<table>
<thead>
<tr>
<th>Principle or Theory</th>
<th>Explanation of Relevance to Professional Learning Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psycholinguistic Theory (Chomsky 1957)</td>
<td>Proposes transformational grammar processing accounts for language acquisition, application, and conceptual understanding. This is unique in that it argues people use both sides of the brain during reading and writing comprehension, not just the speech generation or hearing temporal lobe areas (Chomsky 1957; 1959; Byrnes and Fox 1998).</td>
</tr>
<tr>
<td>Information Pickup Theory (Gibson 1966)</td>
<td>Argues perception depends upon non-cognitive interaction between organisms and the environment. The proposition here is professional learners may need combinations of physiological and verbal activities to learn (e.g. talking and/or chatting during online presentations), and using both (more than one psychoanalytic method) is better than one alone (Strang 2004a).</td>
</tr>
<tr>
<td>Connectionism (Thorndike and et._al. 1928)</td>
<td>One of key principles in Thorndike’s original stimulus-response framework, which posited learning is result of associations (habits) forming between stimuli and responses, the former become strengthened or weakened by nature and frequency of repetition, with the main research principle being that behavior could be observed an predicted without having to know the internal cognitive activities. Repetition in study still works and is used in the design.</td>
</tr>
<tr>
<td>Drive Reduction Theory (Hull 1943)</td>
<td>Variation of stimulus-response added intervening variables to explain behavior (such as initial drive, incentives, inhibitors, prior training, habit strength). Like other forms of conditioning, reinforcement is the primary factor that determines learning, but lower-level drive reduction (need satisfaction) plays a much more important role in cause-effect.</td>
</tr>
<tr>
<td>Sign Learning / Purposive Behaviorism (Tolman 1932)</td>
<td>Bridge between classical behaviorism and cognitive theory - emphasizes relationships between stimuli rather than stimulus-response (Tolman 1942). Relevant as it argues learning depends on means-end readiness, (i.e. goal-oriented behavior), mediated by expectations, perceptions, representations, and other internal or environmental variables (Tolman 1922).</td>
</tr>
<tr>
<td>Volition</td>
<td>Will power and control are seen as a psychoanalytic principle linked to self-regulation and andragogical motivation, specifically as an action-oriented propensity. Inner speech (self-talking) strategies are a further functional component of mental control, and are applied towards goal achievement (Vygotsky 1978; Donald 1991).</td>
</tr>
<tr>
<td>Contiguity Theory (Guthrie 1930)</td>
<td>Added to conditioning by suggesting if a combination of stimuli has accompanied a movement, it will on its recurrence tend to be followed by that movement, with last movement sequence being the ‘learned movement’ since it is the one that will be associated with the outcome (postremity principle)…did not differentiate between rewards and punishment, and forgetting is due to interference rather than the passage (Guthrie 1938).</td>
</tr>
</tbody>
</table>
Psychoanalytic and behaviorism principles have been integrated into contemporary theories of complex cognitive development. Verbalization, for example, particularly when combined with other forms of memory recall such as writing, drawing, and acting, strengthen memory retention and recall, as well as improve the personal schema (concept understanding). Verbalization during the knowledge construction cycle (as discussed earlier) was found to be important during preliminary learning goal theory pilots (Strang 2004a). For example, during graduate-level online courses, professionals positively acknowledged the conceptual learning value from their online synchronous presentations and the asynchronous textual group dialogues (discussion forum postings).

My theoretical explanation for the importance of verbalization to self and peers during learning is that the underlying principle of reflective knowledge reconstruction would apply since when a person is either writing, drawing, or speaking, they are accessing information previously stored in the brain, but they are more deeply interpreting it within the present context. I argue it doesn’t necessarily matter which method of critical reconstruction is used (writing, drawing, speaking, etc. – even other ways such as sign language might achieve the same end), instead it is the process of re-constructing knowledge, but most importantly in a context that is different than the original learning event, and likely one that contains performance motivation (such as peers, friends, etc.).

2.5.2. Cognitive Development Ideologies

Cognitive educational psychology emerged because behaviorism was seen as inadequate for explaining feelings, mental imagery, introspection and other phenomena that could not be directly linked to specific stimuli and responses, or even unrelated to behavior (Winn and Snyder 1996). Cognitivism is split into what I call mental representations and functioning, as well as anthropological adaptation.

Essentially, basic cognitive development in educational psychology revolves around mental structures and processes. In terms of cognitive mental functioning, memory and recall are the key elements discoursed in the literature, such as the short-term memory recall concept of "the magical number seven" (Miller 1956; Miller, Galanter and
Pribram 1960, p. 81), and the related concept of ‘chunking’ large amounts of information into smaller manageable quantities (the latter is also a variation of the project management work breakdown decomposition principle). Miller conducted studies that appeared to indicate humans are only capable of remembering seven discrete bits of information without somehow ‘processing’ them. Likewise, he argued an average span of judgment (ability to discriminate between different classes of one type of data) is also limited to seven. He suggested that people could overcome this limitation by ‘chunking’ information, which is storing and re-coding small bits of information into larger chunks, until all of them are connected into meaningful information, available for recall as a particular domain of knowledge.

The adaptation aspect of cognitive development deals with the systemic cycle of learning, beyond simple memory-recall processes. Some literature broadly describes this as equilibration, evolution, adaptive/generative learning, duetero (triple loop) learning (discussed earlier re: Tynjala and Hakkinen 2005; Waight and Stewart 2005a), organizational learning, knowledge creation cycle, and so on (Strang 2003). The idea with adaptive cognition is that the original learned item or process is augmented, enhanced, or otherwise improved, by applying critical thinking and/or peer dialogue. Groups may be involved in this process, or other aspects of the social environment, to contribute to this learning process. Furthermore, this process may involve peers in an asynchronous (latent learning, time elapsed, one by one contribution), or synchronous (everyone collaborating together simultaneously). Contextual development theory also evolved from this and is considered an important facet of constructivism (discussed next). Table 2.2 is a synthesis of the most relevant cognitive development principles.

**Table 2.2: Synthesis of Cognitivist Learning Principles from Literature**

<table>
<thead>
<tr>
<th>Principle or Theory</th>
<th>Explanation of Relevance to Professional Learning Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestalt Theories</td>
<td>Advocates knowledge organization principles during cognitive perception and problem-based learning.</td>
</tr>
<tr>
<td>(Wertheimer 1959)</td>
<td>Basic building block of information processing, a cognitive knowledge structure that accommodates memory storage and that facilitates information recall as well as mental processing (Bartlett 1932; 1958). Schemata organize small bits of information into larger representations to give meaningful comprehension (Anderson 1983).</td>
</tr>
<tr>
<td>Schema (Bartlett 1932)</td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td></td>
</tr>
<tr>
<td>Processing Theory</td>
<td></td>
</tr>
<tr>
<td>(Miller, Galanter and Pribram 1960)</td>
<td>‘Chunking’ information into memory storage followed by retrieval – builds on other theories to suggest schemata and conceptual understanding are created in small steps.</td>
</tr>
<tr>
<td>Principle or Theory</td>
<td>Explanation of Relevance to Professional Learning Approach</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>Goal-Operator-Method-Select (Card, Moran and Newell 1983)</td>
<td>GOMS is a computer software development methodology applied to cognitive reasoning, and it is based upon an information processing, GPS, and SOAR theoretical principles. The methodology can be applied to general learning and problem solving situations (Olson and Olson 1991; Oray, John and Atwood 1993).</td>
</tr>
<tr>
<td>Meta-Cognition (Flavell 1976)</td>
<td>Complex problem solving, thinking about and controlling how to learn. Metacognition advocates active monitoring and regulation (executive control) system that many cognitive theorists have included in their goal, reasoning, planning, problem-solving, evaluation language learning, and other theories.</td>
</tr>
<tr>
<td>Cognitive Load Theory (Sweller 1988)</td>
<td>Extension chunking and information processing theory, by using efficiency metrics (statistical and plot diagrams) to help ‘cognitively load-balance’ instructional materials…has been broadened to learning by removing extraneous, intrinsic, and germane schema elements, paced over courses.</td>
</tr>
<tr>
<td>Structural Learning Theory (Scandura 1970)</td>
<td>Similar to meta-cognition in that what is learned are rules which consist of a domain, range, and procedure. The theory also suggests a strategy for individualizing instruction by analyzing which rules a student has/has not mastered and teaching only the rules, or portions thereof, that have not been mastered (Scandura 2004).</td>
</tr>
<tr>
<td>Latent Learning</td>
<td>Learning does not necessarily follow observation - people can learn without immediate practice or performance. Thus contextual development adds interpretative value to the cognitive development and adaptation theories.</td>
</tr>
<tr>
<td>SOAR (Laird, Newell and Rosenbloom 1987)</td>
<td>Simulation model (referred to as an architecture for human cognition expressed in the form of a production system) which builds upon earlier efforts of GPS (Newell 1990) and GOMS.</td>
</tr>
<tr>
<td>Anchored Instruction (Bransford 1990)</td>
<td>Developed by Bransford in conjunction with Cognition &amp; Technology Group at Vanderbilt University (CTGV 1993), to leverage technology (videodiscs) to encourage students and teachers to pose and solve complex, realistic problems, whereby videos served as anchors for subsequent learning.</td>
</tr>
<tr>
<td>Conversation Theory (Pask 1975)</td>
<td>Extends self-talking psycholinguistics by suggesting real learning can be improved understanding the relationships among the concepts, through explicit explanation back to the teacher. Pask also differentiates between the manner of learning relationships as being serialists (one fact at a time) versus holists (consider everything then progress into details as appropriate).</td>
</tr>
<tr>
<td>Repair Theory (Brown and VanLehn 1980)</td>
<td>People primarily learn procedural tasks by induction and bugs occur because of biases that are introduced in the examples provided in the feedback received during practice, as opposed to mistakes in memorizing formulas or instructions (VanLehn 1990). Thus repair theory explains how conceptual errors can manifest in our ‘personal theories’ and ‘mental models’.</td>
</tr>
<tr>
<td>General Problem Solver/GPS (Newell 1990)</td>
<td>‘Means-ends’ methodology for solving problems stated in the form of a simulation script (related to script theory discussed later). Often used in adult learning to simulate critical thinking and practice-based learning (e.g. cases).</td>
</tr>
</tbody>
</table>

The most relevant aspect of cognitive development theory to highlight in the professional learning context is the interaction of perception and motivation and how they impact remembering and ‘reflective’ information processes associated with schemata. *Individual constructivism* in professional learning is a way to explain this interaction of cognitive rationalization and perception. This is again another application of the stakeholder model, superimposed on educational psychology principles, in that as earlier research has stated, it is people (individuals) whom ultimately learn, create, and share knowledge, while they do so in various organizational and social contexts (Strang...
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2003). For example you can imagine that ‘where’ you learn impacts ‘what’ (e.g. noise, culture, classroom, online, group dialogue, reading, relaxed versus stressed environment, etc.).

Furthermore, the ideas of equilibrium and constructivism underpin much of the theory articulated by contemporary knowledge creation literature (Nonaka, Toyama and Konno 2001; Wiig 2001). The proposition upheld here is that organizations and teams don’t learn – yes groups of people can brainstorm and use sense-making to produce more together than individually, but it is the individual who actually ‘constructs’ meaning and biologically stores it within the schemata; even written or visual knowledge structures must be ‘processed’ and encoded by individuals and re-constructed before it can be applied; thus real learning is like life itself, a phenomenon that is ultimately and truly experienced by the individual. The literature concurs that professional learning is experienced at the individual ontological level even within organizational knowledge frameworks (Awad and Ghaziri 2004; Becerra-Fernandez, Gonzalez and Sabherwal 2004).

2.5.3. Relevant Humanistic Learning Principles

The humanistic orientation stems from mainly from psychology and social psychology, and as such it covers both the individual and social emotive drivers in adult learning. These principles are leveraged again in the discussion about constructivism.

Motivation and ‘readiness’ are proposed here as key tenets for effective project manager learning (but there are others as will be discussed later). Motivation and readiness are complicated terms to define at this early stage, but a simple explanation is that they are both driven through self goal-setting and enabled through flexibility (e.g. anytime, anywhere, any format learning). Motivation and self-goal-setting are provisioned from self-regulation and self-efficacy (confidence) principles, the latter of which, specifically confidence in a specific skill or subject, relates to cognitive schema development representing domains or topics of knowledge (explained later). Already at this point we have briefly touched on some very key elements which are important to explain for adult learning theory. Motivation, self-regulation, and self-confidence, alone are not
sufficient, as there is a multitude of other significant concepts, such as those of the
cognitive development domain, social learning, and these are from the learner
perspective. In addition to this, there are many concepts that can help to explain the
process of learning from an instructional vantage point, many which still apply as
course design guidelines for situations involving planned self-directed learning.

Table 2.3: Synthesis of Humanistic Learning Principles from Literature

<table>
<thead>
<tr>
<th>Principle or Theory</th>
<th>Explanation of Relevance to Professional Learning Approach</th>
</tr>
</thead>
</table>
| Hierarchy of Needs (Maslow 1943)     | 1. Physiological: basic survival needs, such as food, water or shelter;  
                                          2. Safety: environment safe from external dangers;  
                                          3. Social: need for affection and relationships;  
                                          4. Esteem: drive for feelings of self-worth and individual importance;  
                                          5. Self-actualization: sense of fulfillment, maximize growth, contribute to others. |
| Attribution Theory (Weiner 1974) &   | People are unaware of actual factors contributing to behavior therefore they  
                                          Naïve Analysis (Heider 1958) | ‘attribute’ outcomes to internal personal forces and/or external environmental  
                                                                                                                                                             determinants (Heider 1958). Attribution concept was later extended into a  
                                                                                                                                                             comprehensive attribution theory (Weiner 1974) to explain how people perceive  
                                                                                                                                                             the cause/effect of other’s behavior’s. Weiner also based his concept on  
                                                                                                                                                             achievement theory meaning outcomes are attributed to effort, ability, level of task  
                                                                                                                                                             difficulty, and/or luck (Weiner 1980). His framework classified the locus of  
                                                                                                                                                             control dimension as internal versus external, the event as being stable or  
                                                                                                                                                             changing over time, and controllability, such as skill/efficacy which can be  
                                                                                                                                                             controlled as compared with aptitude, mood, others’ actions, and luck which  
                                                                                                                                                             cannot (Weiner 1986). |
| Expectancy Theory                    | Differs from attribution theory in that expectancy is a pre-task condition; behavior  
                                          is a function of how much one values a particular outcome, along with their  
                                          expectation of obtaining that outcome if they perform that behavior (Weiner 1986;  
                                          Wigfield and Eccles 2000). In professional learning people consider attributions of  
                                          previous accomplishments in forming context-sensitive motivational expectancies,  
                                          and thereby set appropriate conceptual and performance goals accordingly. An  
                                          important interpretation of expectancy as it may apply to learning goals is that  
                                          repeated success builds perceptions of self-efficacy, whereby this would promote a  
                                          learning spiral of choosing incrementally more difficult objectives. |
| Balance Theory (Heider 1958)         | Asserts people tend to ‘cognitively balance’ their perception and understanding  
                                          between three factors: other people/stakeholders, situations, and events (Heider  
                                          1958). These perceived ‘balances’ could be various combinations of negatives  
                                          and/or positives, essentially forming a rationalist personal model in their mind,  
                                          while they try to maintain a homeostatic balance. |
| Cognitive Dissonance (Festinger 1957) | Complimentary to Balance Theory, arises when beliefs, attitudes, opinions, and behaviors differ so we try to rationalize them (Festinger and Carlsmith 1959). Also  
                                          explained in the literature as epistemic doubt (Andre and Windschitl 2003), and  
                                          disequilibrium (as described by: Piaget 1970). |
| Equilibration Theory (Piaget 1952)   | Another key principle linking behaviorism, constructivist ideology, and cognitive  
                                          development learning theory.- explained as a biological drive to produce an  
                                          optimal state of adaptation between the environment and one’s cognitive structures  
                                          (Piaget and Inhelder 1969; Piaget 1970; Duncan 1995). Piaget (1952) theorized  
                                          equilibration (motivating force to balance) contributes significantly to cognitive  
                                          development along with three other dimensions: biological maturation, experience  
                                          with the physical environment, and experience with the social environment. |
### Principle or Theory

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<th>Principle or Theory</th>
<th>Explanation of Relevance to Professional Learning Approach</th>
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| Motivation Theory                    | 1. Achievement – drive to excel, strive to succeed, for high performance standards, realize goals and high-quality deliverables, continuously learn;  
2. Power – need to influence behavior of others, desire to control others;  
3. Affiliation – social association, identification/membership with a group, desire for friendly and close personal relationships with co-workers.  
Advancements to this related to professional learning are Alderfer’s Existence-Relatedness-Growth framework (Wigfield and Eccles 2000). |
| Rebel Leadership                      | “Leaders inducing followers to act for certain goals that represent the values and the motivations – the wants and needs, the aspirations and expectations – of both leaders and followers” (Burns 1978, p. 19). This also relates to social learning and adaptation as “a micro-level influence process between individuals and a macro-level process of mobilizing power to change social systems and reform institutions” (Yukl, 1989, p. 271). |
| Self-Leadership                       | Includes a set of strategies that an individual uses to improve their own behavior, which can include cognitive learning, goal planning, and self-regulation. |

#### 2.5.4. Constructivist Rationalization

When discussing constructivism it is interesting to recite the importance of perception and rationalism as originated by Plato, Aristotle and the other ancient philosopher kings. Contemporary knowledge management theory asserts that what is known in the mind is affected by perception, which is generally explained as “the justified truth of what individuals believe at a point in time, which can change over time and from one context to another” (Strang 2003, p. 3). From the educational psychology macro-perspective, the constructivist ideology argues knowledge is subjective and personal, mentally constructed in many different ways, as a working hypothesis (Simpson 2002), people are active learners and therefore construct meaning for themselves (Geary 1995), which is influenced by interaction with the social environment (Bandura 1986; 1997).

Constructivism emerged to overcome perceived inadequacies of cognitive educational psychology, "to establish meaning as the central concept of psychology" (Bruner 1990, p. 2), and it borrowed principles from psychology, anthropology, sociology, philosophy, and "the humanities" to do so. It is acknowledged by many writers that cognitive psychology made significant improvements to education theory, as it was "intended to bring the ‘mind’ back into the human sciences" (Bruner 1990, p. 1).

Constructivism added the ‘justified true perception’ and rationalistic meaning, to what is learned and known. This in particular refers to the idea that learning is tied to the whole context (like the open systems stakeholder model in Figure 2.2), and inextricably tied to
the individual’s intentional states which are formed "only through participation in the symbolic systems of the culture" (Bruner 1990, p. 33). Similar social-learning ideas originate from Vygotsky who asserts "mental functioning occurs first between people in social interaction and then within the child on the psychological plane”, and “the very structure of individual functioning derives from and reflects the structure of social functioning” (Vygotsky 1978, p. 1-2). Constructivist learning is not less important than adaptive learning of social development theory, it is just different in that the former gives it the critical rationalization, while the latter provides a systemic critical reflection.

The social context also impacts constructivist learning. From the individual perspective, social cognitive learning supports the concept that people learn vicariously from their social contexts, observing models, listening to instructions, and by engaging with print/electronic materials, in an active fashion (Bandura 1986). At the macro level of analysis, the social context also applies influence to motivate the professional learner, which we may know as culture, norms, and competitive goals. There are many constructivist and social context related principles underlying the professional learning approach proposed in this thesis, with the pivotal ones highlighted in Table 2.4.

Table 2.4: Synthesis of Constructivist Learning Principles from Literature

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<th>Principle or Theory</th>
<th>Explanation of Relevance to Professional Learning Approach</th>
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<tr>
<td>Knowledge Creation Cycle (Nonaka and Teece 2001)</td>
<td>Systemic process of individual and social schemata creation. Explicit knowledge – are those which have been articulated and captured in various forms – text, tables, diagrams, formulas, product specifications, etc. Tacit knowledge – are those that cannot be articulated, and where “the knowing is in the doing” Implicit knowledge – this is knowledge that can be articulated but isn't. Its existence is implied by or inferred from observable behavior or performance Self-transcending knowledge - “.intuition” (Nonaka and Teece 2001, p. 17) and “not yet embodied” (Scharmer 2001, p. 71).</td>
</tr>
<tr>
<td>Phenomenography (Entwistle and Ramsden 1983)</td>
<td>Conceptual framework that draws attention to the experience of learning from the student’s perspective and is based upon a phenomenological approach to research. Related to introspection (observation) method in psychological research and has been related to learning styles (Marton, Hounsell and Entwistle 1984).</td>
</tr>
<tr>
<td>Principle or Theory</td>
<td>Explanation of Relevance to Professional Learning Approach</td>
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| Cognitive Learning Styles (Kolb 1984) | Styles of experiential learning that involves four principal stages:  
1. Concrete experiences (CE),  
2. Reflective observation (RO),  
3. Abstract conceptualization (AC),  
4. Active experimentation (AE).  
"Recent theoretical and empirical work is showing that the original four learning styles—assimilating, converging, accommodating, and diverging— can be expanded to show nine distinct styles...[of which the four new ones: Northerner, Easterner, Southerner, and Westerner] fall between the origin ones" (Kolb and Kolb 2005, p. 197). |
| Triarchic Theory (Sternberg 1977) | Links cognitive processing to cognitive learning styles  
1. Componential sub-theory which outlines the structures and mechanisms that underlie intelligent behavior categorized as meta-cognitive, performance, or knowledge acquisition components;  
2. Experiential sub-theory that proposes intelligent behavior be interpreted along a continuum of experience from novel to highly familiar tasks/situations; and,  
3. Contextual sub-theory which specifies that intelligent behavior is defined by the sociocultural context in which it takes place and involves adaptation to the environment, selection of better environments, and shaping of the present environment. |
<p>| Aptitude Treatment Interaction (Cronbach and Snow 1977) | ATI is a framework for conducting research based on the assumption that fundamental learner differences will affect what instructional (guidance) methods are most appropriate (Cronbach and Snow 1981). The main argument is &quot;learning style differences can be linked to relatively stable person or aptitude variables, but they also vary within individuals as a function of task and situation variables&quot; (Cronbach and Snow 1977, p.51). |
| Double-Loop Learning (Argyris and Schön 1978) | Individual change theory that philosophically lies somewhere between, or a combination of, action science, psychoanalysis, constructivism and complex cognitive adaptation - implies motivation and leadership, at least from its application in management science, organizational learning and knowledge creation in particular (Argyris 1995; Argyris and Schön 1996). It is based upon a 'theory of action' perspective that advocates learning by examining reality from the point of view of human beings as actors, such that changes in values, behavior, leadership, and helping others, are all part of, and informed by, the actors' theory of action, which means their perception and understanding of what they do upon critical self-reflection. |
| Adaptive Learning | Based on metacognition, complex cognitive memory processing concepts, and knowledge creation principles - implies people use a mental model (knowledge maps, schemas) to connect ideas and represent personal theories, which tend to be further developed, modified, or replaced with new experience and learning overtime. Relevant to professional learners since they tend to be anchored in two social domains of learning, firstly, as a community of practice to further for their own career development, and secondly, contributing to organizational learning to help the business entity evolve. |
| Systems Modeling (Forrester 1981) &amp; Five Thinking Disciplines (Senge 1990) | Formalized science in system dynamics which uses feedback control diagrams to help create and articulate concepts, which draws on complex cognitive development principles, action science, and the third stage of the Kolb's adult learning cycle (abstract conceptualization). Extended by defining five disciplines for organizational adaptation and survival - system thinking, personal mastery, shared models, team work, and visioning (Senge 1990). |</p>
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<th>Principle or Theory</th>
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<tr>
<td>Zone of Proximal Development (ZPD) (Vygotsky 1978)</td>
<td>Collaboration and interaction with more advanced peers in the sociocultural context allows learners to advance more than they could otherwise do so individually. The learning boundary of the ZPD is ‘the distance between actual development level as determined through problem solving under adult guidance or in collaboration with more capable peers’ (Vygotsky 1978, p. 86). This blends well with goal-setting, self-efficacy, and motivation, if professional learners set ‘stretch-goals’ based on wanting to advance to peer-level status.</td>
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<tr>
<td>Social Learning Theory Self-Efficacy, Self-Regulation (Bandura 1977b)</td>
<td>Emphasizes the importance of iteratively observing and modeling the behaviors, attitudes, and emotional reactions of others, in order to learn. It is related to the ZPD concept, but it is more detailed. The processes underlying social learning are: 1. Attention, including modeled events (distinctiveness, affective valence, complexity, prevalence, functional value) and observer characteristics (sensory capacities, arousal level, perceptual set, past reinforcement); 2. Retention, including symbolic coding, cognitive organization, symbolic rehearsal, motor rehearsal); 3. Motor Reproduction, including physical capabilities, self-observation of reproduction, accuracy of feedback; and 4. Motivation, including external, vicarious (observing others) self reinforcement. The social learning theory also makes explicit use of the concept of self-efficacy, self-regulation, self-schema, and attention motivation (Bandura 1986; 1997), which are all discussed in detail in a following subsection.</td>
</tr>
<tr>
<td>Functional Context Principle (Sticht 1976)</td>
<td>Stresses the importance of making learning relevant to the experience of learners and their work (social) context. The underlying principle is that learning new information can be facilitated by relating it to knowledge already possessed, and secondly that old knowledge can be transformed into new knowledge. This theory also suggested using multimedia and technology to assist developing a realistic context (Carnevale, Gainer and Meltzer 1990). Although social and functional contexts are not identical terms, I suggest they are related.</td>
</tr>
<tr>
<td>Sociology &amp; Coping Model</td>
<td>Group behavior - also inform social cognitive development. The coping model idea emanates from sociology and it is also relevant for teaching adults since many people across cultures benefit from observing humility; they learn by observing peers overcome difficulties to achieve obtainable goals; which bolsters their own self-efficacy. What is important in the coping model concept is that the subject must appear to have a constraint and rational solution that are perceived to be realistic and relevant to the learner.</td>
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<tr>
<td>Social Psychology</td>
<td>Interaction and behavior of the individual with peers, the organizational entity and the organizational culture. Social psychology is also described as organizational behavior (referring to how individuals behave within organizations). Social psychology describes the interactions within and across the boundaries, based on these principles: 1. the individual is an entity having motives and resources; 2. relations between individuals (interpersonal relations) are composed of identities; 3. the social organization is comprised of interdependent sets of roles; and 4. the organizational culture is a system of shared beliefs.</td>
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<tr>
<td>Social Exchange Theory &amp; Community of Practice (Wenger, McDermott and Snyder 2002)</td>
<td>Similar to many other social psychology principles - can impact the group aspect of learning, in that learners in a community, virtual (online) or classroom-based, will exhibit the dynamics of power, informal leadership, respect, social approval, esteem, loyalty, trust, and so on. The behavior and dynamics of the group can improve and/or impede individual learning by affecting a learner’s interest, motivation, self-efficacy, and team performance.</td>
</tr>
<tr>
<td>Principle or Theory</td>
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<tr>
<td>Reciprocal Determinism (Bandura 1986; 1997)</td>
<td>Cognitive functioning processes, overt behavior, and environmental factors, all interact in a complex manner some as direct causes, some as indirect causes, others as effects, to explain adult social behavior. The theory posits an individual’s forethought directs their behavior and produces environmental outcomes which are perceived, and may cause the original thoughts or behavior to be modified. Alternatively, certain contexts can cause people to think in different ways, which call upon them to behave in a manner intended to maintain or modify the environment. As people behave, their actions and the environmental outcomes produced are monitored in relation to predetermined goals and beliefs. These observations may reaffirm the original beliefs or lead them to be modified. A triadic relationship of interactive cause and effect is thus established between the three components of cognition, behavior and environment (Bandura 1986; 1997; Schunk 2002). This is in essence also an underlying model of self-regulation (discussed later).</td>
</tr>
<tr>
<td>Mentoring</td>
<td>Process that can improve adaptive learning, by using experts to help novices understand and develop conceptually correct personal theories. The expert is usually taken from a particular knowledge domain because of their considerable long term practice and experience with particular subject matter. Experts are paired with novices. Research on novice versus expert performance (Chi, Glaser and Farr 1988) suggests that the nature of expertise is largely due to the possession of schemas that guide perception and problem-solving.</td>
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<tr>
<td>Situated Learning Theory (Lave and Wenger 1991)</td>
<td>Social psychology principle loosely based on concepts of anchored instruction, lateral thinking, functional context, knowledge creation, and phenomenography. It asserts that learning is a function of the activity, context and culture in which it naturally occurs. Social interaction is a critical component of situated learning, specifically, the participants are considered part of a &quot;community of practice&quot; which embodies certain beliefs and behaviors to be acquired. As the beginner or newcomer moves from the periphery of this community to its center, they become more active and engaged within the culture and hence assume the role of expert or old-timer. What is significant about this theory is that learning is usually unintentional rather than deliberate, as well, it requires social interaction and collaboration.</td>
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<tr>
<td>Cognitive Apprenticeships (Collins, Brown and Newman 1989)</td>
<td>Related construct to mentoring and situated learning - infrastructure enabling students to acquire, develop and use cognitive tools in an authentic domain activity, stimulated by collaborative social interaction and the social construction of knowledge. This also applied the sociology principle of coping models and the social psychology concept of expert-novice pairing.</td>
</tr>
<tr>
<td>Script Theory (Schank 1975)</td>
<td>Intended to explain language processing and higher thinking skills, built in the key idea of conceptual dependency theory which is that all conceptualizations can be represented in terms of a small number of episodic events (thus supports chunking concept). This is most applicable to professional learning because scripts allow people to make inferences needed for understanding by filling in missing schema information (which is how we develop personal theories and a bounded rationality). Extensions to script theory added planning (Schank and Abelson 1977) and story-telling (Schank 1991).</td>
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2.5.5. **Key Humanistic-Constructivist Professional Learning Principles**

Bandura’s work in social learning principles has the largest impact on this thesis professional learning vision. His social learning theory explains learning as observational learning by first organizing and rehearsing the modeled behavior symbolically and then enacting it overtly. Modeled behavior is then encoded into words, labels or images, which results in better retention than simply observing (Bandura...
Individuals are more likely to learn and adopt a modeled behavior if it results in outcomes they value (expectancy theory). Also, people are more likely to adopt a modeled behavior if the model is similar to the observer and has admired status and the behavior has functional value (related to attribution theory). Thus it is evident that Bandura integrated theories from all of the educational psychology schools of thought in his powerful and influential theory. The key facets of his work are discussed below.

**Self-efficacy** has been recognized as a desirable trait in charismatic and transformational leadership, both from the instructor as a leader perspective, as well as from the learning as a self-leader viewpoint. Studies of transformational and charismatic leadership indicate that people with high self-efficacy are willing to expend more effort and persist longer in overcoming obstacles to the attainment of task objectives (Bandura 1986; Yukl 1998). From the instructional perspective, charismatic leaders can enhance follower **self-esteem** and self-efficacy by setting high performance expectations and expressing confidence that the professional can obtain these levels. Furthermore, **collective self-efficacy** (group confidence) has also been found to impact leadership, in that if the self-confidence perception of group members is high (such as in a professional community of practice), they are more willing to cooperate as a joint effort and share their experiences-learned. Collective efficacy, referring to the organizational stakeholder, was described earlier in the chapter as empowerment and confidence the instructor and the organization together provide to the learner (Ashton and Webb 1986; Tschannen-Moran, Hoy and Hoy 1998; Goddard, Hoy and Hoy 2000).

**Self-regulation** is a key principle associated with cognitive learning, which could be viewed as including volition (act of using willpower), and as a variant of equilibration in which the learner monitors and adapts using planning, forethought, and self-reflection as a constructive feedback mechanism (generative learning). Self-regulation borrows ideas from the self-leadership principles (individual level of analysis) discussed earlier, in that individuals create strategies to help them achieve their objectives, in conjunction with goal setting and monitoring their progress.
Self-regulation is related to social learning theory (discussed earlier), in that people have beliefs (conditioned by the context and prior learning), they monitor their behavior and the environmental outcomes, and this may lead to subsequent adjustment of behavior or beliefs (Zimmerman and Risemberg 1997). People are guided in their behavioral choices by predetermined goals, an assessment of contextual conditions, along with their own capabilities required in order to achieve them (Bandura 1977b; 1997). Progress towards the goal is monitored and adjustments are made to behaviors, while focusing on a goal (or other self-beliefs) – it is this monitoring of progress that is the key underlying function in self-regulation. Self-regulation includes monitoring one’s own behavior, monitoring the environmental outcomes, and the results generated from it through a series of sub-functions, during which the individual performs comparisons with original goals and other belief constructs (Zimmerman, Bandura and Martinez-Pons 1992). This can also affected by double loop learning, in that people may not realize their perceived beliefs differ from their behaviors.

In the self-regulation model, task goals can vary according to their level of specificity, difficulty, temporal proximity, and the standard by which attainment is to be measured. Self-regulation, observations of behavior and environmental outcomes are compared with goal requirements and with past observations to monitor progress towards the goal. Thus this emphasizes goal monitoring as well. Monitoring feedback is used as a motivational force and to provide guidance about necessary behavioral adjustments to enable goal attainment, as well as to modify perceptions of the goal’s attainability, or even to modify aspects of the goal itself (Zimmerman, Bandura and Martinez-Pons 1992; Zimmerman and Risemberg 1997). The quality of the behavior, its efficiency in producing desired outcomes, and other attributes such as its moral or ethical fidelity may also be observed depending on the beliefs most highly valued by the individual (Bandura 1977b; 1997). A significant learning goal aspect to the theory is that attributes of the behavior that intersect with issues viewed as important to the individual’s goal and behavioral standards are those more likely to be most stringently monitored. These processes have been observed in the development of new skills and in the performance of tasks by experts in disparate fields of endeavor (Zimmerman, Bandura and Martinez-
Pons 1992; Zimmerman and Risemberg 1997) and they have significantly impacted this professional learning goal research model building.

An individual may also meta-cognitively monitor the quality of the self-regulation (which I refer to as critical self-reflection or others would call it double loop learning). For example, perhaps an individual is not monitoring frequently enough to gain a true perception of reality. Monitoring which is temporally distant from the behavior or inaccurate would reduce the quality of the information obtained and thus reduce its influence on future behavior. Behavioral observations must be judged to provide feedback for adjustments to future behavior or beliefs, and also to provide immediate self-reactions of relative satisfaction or dissatisfaction with behavioral quality and progress. In the professional learning model, this takes place as learner-initiated regular self-monitoring (not necessarily instructor feedback). Judgment perceptions are based on personal standards that develop from past experiences, vicarious (social observation), social sources, and from references to comparative groups (cultural norms) with whom the individual identifies – this is derived from sociology theory. The judgment perception of a performance depends on comparisons with an individual’s past performance, the relative performance of similar others, and whether the behavior is adequate to meet the goal requirements (Bandura 1986; Zimmerman, Bandura and Martinez-Pons 1992; Bandura 1997; Zimmerman and Risemberg 1997; Schunk 2004). Thus, professional learning goals are not singularly self, instructor or context-driven, they are a combination.

Self-regulation borrows heavily from the humanistic theories discussed earlier. Those performances that are judged highly will build the individual’s sense of efficacy for the task and provide motivation for continued engagement with the task (Bandura 1997; Zimmerman and Risemberg 1997). Motivation is further mediated by the value ascribed to the successful performance of the activity and the responsibility assumed for the outcomes observed. Successful performance in a highly valued task, in which an individual attributes outcomes to personal effort, is likely to provide strong motivation for the continuance of that behavior (Bandura 1977b). On the other hand, unsuccessful performance under those conditions will likely induce considerable stress. Furthermore,
successful performance in tasks considered of little value or where outcomes are attributed to factors external to the individual will have little motivating force (Schunk and Hanson 1989; Bandura 1997; Zimmerman and Risemberg 1997; Schunk and Ertmer 2000). Values and attributions may also be affected by performance monitoring so that an individual may ascribe a higher value to activities in which successful performance is observed. Activities in which poor performance is observed may be devalued or outcomes attributed to external factors. This is related to the principle of reciprocal determinism (discussed earlier) in that the outcomes of behavior may thus prompt a reappraisal of the beliefs held (Bandura 1977b).

An additional humanistic element in social learning theory self-regulation is self-reaction which is the expectancy and satisfaction value balancing. An individual may feel self-satisfied, neutral, or apply even self-censure, as a reaction to monitoring behavior (Bandura 1977b), which refers to positive, negative, or no action. These self-reactions may be restricted to affective influences or may involve tangible self-reward for perceived successful performance (Bandura 1997; Schunk and Ertmer 2000). This is inextricably linked to goal-setting and reward expectancy, since as adults we often set positive goals for ourselves (e.g. look forward to a small reward if we achieve something). In self-regulation theory, before engaging in goal-oriented behavior, people anticipate outcomes that involve positive self-evaluation (expectancy). Positive self-reactions confirm the anticipated self-satisfaction and motivate continued effort. Self-reactions that lead to self-censure or fail to provide anticipated positive outcomes may lead the individual to either modify, or withdraw from the behavior. Reactions can be complex, and interactions with other beliefs, such as self-efficacy, may produce different behavioral responses. Thus, in terms of professional learning, there is a significant humanistic, social, and complex cognitive relationship between motivation, expectancy, goal setting, self-regulation and learning.

Additionally, the self-regulation concept within social learning theory explains how the reciprocal relationship between beliefs, behaviors and environmental conditions affect learning self-efficacy (confidence in a specific subject or skill). Self-regulatory systems lie at the very heart of causal processes in self-regulation and therefore they explain
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human behavior as purposive, is regulated by forethought (Bandura 1997). Forethought is the link to the goal-planning and self-efficacy aspects of the theory. As explained by Bandura, individuals initiate behavior, perceive and regulate its expression and observe its product through self-regulatory cognitive processes, and in doing so they apply effort based on expectancy of success, which as we know from the earlier section explaining motivation and leadership, is conditioned by the value associated with the reward, and it is also conditioned by how confident we are to achieve it. Thus an individual’s self-efficacy belief is a major determinant towards performance because unless people believe they can produce desired effects by their actions, they have little incentive to act (Bandura 1997, pp. 2-3; Schunk and Ertmer 2000).

**Self-efficacy** is in fact a fundamental professional learning principle posited here, which is defined as “an individual’s judgments of his or her capabilities to perform given actions” (Schunk 1991, p. 207), and “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performance” (Bandura 1986, p. 391). Self-efficacy is differentiated from self-concept (confidence) in that the former is a specific view of one’s capabilities in a single context rather than a general capability across functional domains (Marsh and Shavelson 1985), and it advocates that a learner’s self-feelings affect their behavior, choice of activities, goal setting, effort, value expectancy, persistence, determination, and ultimately their conceptual learning achievement. Self-efficacy for example, is holding a confident perception and goal that a project manager can perform a fair performance assessment on an under-performing but popular team member using tools such paired appraisals and techniques such as evidence-based constructive feedback, whereas self-confidence would imply overall, a project manager feels s/he can apply human resource techniques during performance evaluations.

Self-efficacy clearly is not the only determining impacting self-regulation, since an individual’s belief system, behavioral repertoire, and self-regulatory processes influence the choice of behavior. Some writers contend that belief constructs are pivotal in behavioral expression and that self-efficacy beliefs are predominant amongst the constructs that influence behavior. Self-efficacy influences the activities chosen, the
goals and difficulty level set, effort and enthusiasm applied, level of persistence in the
face of difficulty, and affective self-reactions, and therefore these influences of self-
efficacy play a pivotal role in determining behavioral choices (Bandura 1977b). There
seems little doubt that self-regulatory processes, and the self-efficacy belief construct in
particular, are influential in the determination and maintenance of individuals’ behavior
in diverse activities (Bandura 1977b; Zimmerman, Bandura and Martinez-Pons 1992).

Since these humanistic principles are viewed as pivotal in this thesis, their theoretical
conceptualization, systemic interaction, and action learning experiences (Strang 2004a;
Strang 2005c; 2005f; 2005d), will be discussed and presented in more detail below.

Figure 2.7 illustrates an integrated view of self-regulation, self-efficacy, and
professional learning goal setting that I have adapted from social learning theory and its
underlying principles as explained above. Towards the bottom diagram, the self-
regulation sub-functions are shown. The key enhancement I have made to their theories
is to show the expectancy/feedback loop associated with professional learning goal
monitoring and accommodation. This model is a significant influence on this research
(concepts from: Bandura 1977b; Schunk and Ertmer 2000; Schunk 2004).
Research demonstrating the strong influence of self-efficacy beliefs for adult learning has been reported earlier in this chapter, and there is an abundance of additional literature applying a variety of beneficial findings (Bandura 1977a; Ashton and Webb 1986; Bouffard-Bouchard, Parent and Larivee 1991; Zimmerman, Bandura and Martinez-Pons 1992; Gale 1998; Goddard, Hoy and Hoy 2000; Schunk and Ertmer 2000; Arbaugh 2001; Chappidi, Patel and Lawhead 2003; Austin 2004; Burbach, Matkin and Fritz 2004; Cooke 2004; Dunbar 2004; McAlpine 2004; DeShields, Kara and Kaynak 2005; Kirkpatrick 2005). It is a long citation list but the research findings are very significant. As I have noted above, in educational settings there have been numerous studies which have demonstrated the centrality of the self-efficacy construct in influencing the learning of children who have experienced learning difficulties (Schunk and Hanson 1985; Schunk 1991; Schunk and Ertmer 2000). Zimmerman and his colleagues (Zimmerman, Bandura and Martinez-Pons 1992; Zimmerman and Risemberg 1997) have shown the direct and indirect effects, via goal setting of self-efficacy, in educational achievement of both school and college students. As such, it is
posited here that professional learners are likewise impacted by self-regulation, self-efficacy, and goal setting theory, albeit some of the empirical research involves adolescents. I have earlier stated I believe this applies to professional learners.

A related self-regulation topic from the organizational and social level of analysis is *self-help*, which refers to how professionals can apply self-regulation to leverage the social environment and resources to learn. Self-help is sometimes referred to as *self-development* (Schunk 2002). It typically involves formulating a vision of goals (as per self-regulation concepts), seeking appropriate mentors, seeking challenging assignments (or going further than average on them), improving self-monitoring, asking for relevant feedback, critically reflecting on mistakes to meta-cognitively learn, viewing things from multiple perspectives, and using critical inquiry (not accepting customary or easy answers).

A key principle explaining the professional learning goal aspect of self-regulation is the concept of *mastery learning*, and although it is a behaviorist principle, it advocates that students can learn anything in incremental stages, if enough time is allotted. Skinner’s 50-year old programmed instruction was an example of this. Skinner’s theory was founded upon his belief that "experimental study of learning come[s] from devices which arrange optimal conditions for self-instruction" (Skinner 1958, p. 969). He proposed a ‘mechanized instruction’ system of education in which students learned by interacting with machines designed to manage the contingencies and ‘reinforcers’ involved in any given learning task (Skinner 1954). These would not replace teachers, but would leave them free "to function, not in lieu of a cheap machine, but through intellectual, cultural, and emotional contacts of that distinctive sort which testify to [their] status as a human being" (Skinner 1954, p. 96-97). Keller’s Personalized System of Instruction was an improvement to Skinner’s idea in that mastery of a unit at 80% was necessary to continue (Keller and Sherman 1974; Michael 1974; Kulik, Kulik and Cohen 1979) - this literature is an application of performance goal setting and motivation. Further to this is the application of anchored instruction principles that provide scaffolding for cognitive support (I discuss and apply this later in the chapter).
Feedback and reinforcement, in conjunction with andragogical motivation, are the most pivotal concepts propositioned for the professional learning model, which are also common across all the educational psychology ideologies. Feedback involves providing learners with information about their responses whereas reinforcement affects the tendency to make a specific response again. Feedback can be positive, negative or neutral; reinforcement is either positive (increases the response) or negative (decreases the response). Feedback is almost always considered external while reinforcement can be external or intrinsic (i.e., generated by the individual). Feedback, reinforcement, and motivation go hand-in-hand with goal-setting, self-regulation, and self-efficacy (Gage 1978; Shuell 1988; Mayer 2003; Schunk 2004), and these are the important principles argued as necessary to build a professional learning model.

The information processing theories discussed earlier tend to emphasize the importance of feedback in cognitive learning since knowledge of results is necessary to develop accurate schemata, correct faulty personal theories, and formulate new plans. On the other hand, behavioral theories (classical and operant conditioning) focus on the role of reinforcement in motivating the individual to behave in certain ways, thus they also make a significant yet different contribution to professional learning theory. One of the critical variables in both cases is the length of time between the response and the feedback or reinforcement. In general, the more immediate the feedback or reinforcement, the more learning is facilitated.

My pilot research suggests that formative feedback should not be immediate, but instead provided after a short delay (a day or two at least, but no more than a week) has elapsed after performance (assignment or exam submission completed), to allow for cognitive ‘settling’ (organizing) to mature, and after that, feedback can assist in the critical reflection and knowledge re-construction process. Other research supports this finding that delayed feedback is most beneficial to learning (Thalheimer 2002a).

The model in Figure 2.5 illustrates a holistic conceptualization of ‘best-of-breed’ theories and principles from several of these educational psychology ideologies discussed so far. Note that this concept was built from earlier research, and it was
adapted from other writers (as will be later cited). It also refers to a formal learning context design framework that is discussed later, but showing this diagram at this point helps to illustrate the integrative and complimentary nature of the thesis principles. To understand this diagram, one may view it as an evolution from behaviorist and cognitive thinking towards constructivist ideologies.

Figure 2.5: Integration of Behaviorist, Constructivist, and Social Learning Designs

To design the model in Figure 2.5, I condensed and integrated the behavioral aspects of the ARCS methodology, to show how it developed into the contemporary Nine Event Instructional Approach (discussed later), then I added the important professional learning (andragogical aspects of goal-setting), as well as the situated learning principles from anchored instructional theory (concepts adapted from: Keller 1983; Gagné 1985; Bransford 1990).

2.5.6. Formal Adult Learning Theories

The previous subsections contained basic principles as well as formal theories (the latter being academically recognized and frequently cited), which underlie the professional learning vision of this thesis. This section considers the significant adult-centered formal learning theories that govern the educational philosophy proposed herein. The key relevant and closest rival theories are briefly explained and related to this research.
The main difference between the underlying principles (last subsection) as compared with these formal theories, in terms of the aim of this thesis, is many of the principles are encompassed directly or indirectly (e.g. critical thinking, motivation) in the formal theories, and this thesis research transforms (and reemphasizes) their perspective in new combinations to develop better online learning design and delivery approaches. The better value argued here is the modified adult-centered approach, added to existing design and delivery methodologies (the latter of which will also be discussed later).

Andragogy\(^4\) is the most significant formal adult learning theory influencing this research. It refers to an adult learner-focused approach in education to differentiate it from pedagogy, which is an instructor-led content-focused style. This theory emphasizes that adults are self-directed and should take responsibility for decisions. It makes the following assumptions about the design of learning (Knowles 1984a):

1) Adults need to know why they need to learn something;
2) Adults need to learn experientially;
3) Adults approach learning as problem-solving; and
4) Adults learn best when the topic is of immediate value.

A learner-centered approach to adult education dates back to over 200 years ago in the literature (Mayer 2003), and has been published by writers under various terminology, but the common denominator is the focus on the learner (Lambert and McCombs 1998), the cognitive processes, and the cultivation of knowledge (Mayer 2003). As stated earlier in this chapter, recent literature often applies andragogy concepts but most do not affirm its influence or cite its origins. In practical terms, andragogy means that instruction for adults needs to focus more on the process and less on the content being taught. Strategies such as case studies, role-playing, simulations, and self-evaluation are most useful. Instructors adopt a role of facilitator or resource rather than lecturer or grader (Knowles 1984a; 1984b). Pedagogy (teacher focused methodology) is seen here as less effective for adult learners, such as project managers, because as theorized in

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\(^4\)Andragogy or androgogy in etymology is from the Greek word "anere" for adult and "agogus" Houghton-Mifflin (1994). The american heritage\(^\text{®}\) concise dictionary, USA, 1994 INSO Corporation. It originated with European educators of 1950 as adult-centered learning; different spellings are attributed to literature variations.
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Educational psychology is aimed at child and adolescent students, with the teacher primarily controlling the what, where, when, why, and how of the learning experience.

Consequently andragogy principles are fundamental in designing a professional learning model. A contemporary andragogy structure emphasizes five requirements for learning:
1) Learners need to know why something is important to learn;
2) Learners need to be shown how to direct themselves through information;
3) Topics should be related to the learners experiences;
4) People will must be ready and motivated to learn;
5) Learners need help to establish positive beliefs, overcome inhibitions, and improve behaviors; (adapted from: Peckham and Fallon 2004, pp. 4-6).

Experiential Learning (Rogers and Freiberg 1994) principles are very similar and actually informed by andragogy. Experiential Learning Theory is ‘the process whereby knowledge is created through the transformation of experience… knowledge results from the combination of grasping and transforming experience” (Kolb 1984, p. 41).
Rogers distinguished two types of learning: cognitive (meaningless) and experiential (significant), the former corresponds to academic knowledge such as learning vocabulary or multiplication tables, and the latter refers to applied knowledge such as learning about engines in order to repair a car (Rogers and Freiberg 1994). The key to the distinction is experiential learning addresses the psychological needs and wants of the learner, represented by the qualities of: personal involvement, self-initiated, evaluated by the learner, and pervasive (longer term) effects on the learner (such as conceptual and reflective learning – explained later).

The philosophy underlying experiential learning is equivalent to personal change and growth, and that all human beings have a natural propensity to learn. Therefore the role of the teacher is to facilitate such learning, which requires these five principles:
1) Setting a positive climate for learning;
2) Clarifying the purposes of the learner(s);
3) Organizing and making available learning resources;
4) Balancing intellectual and emotional components of learning; and
5) Sharing feelings and thoughts with learners but not dominating
   (Rogers and Freiberg 1994; Vrasidas and Zembylas 2004; Maclellan 2005; Moon,
   Birchall, Williams et al. 2005; Neal and Miller 2005; Sizoo, Agrusa and Iskat 2005;
   Tynjala and Hakkinen 2005).

There are many good articles of experiential learning theory being successfully applied
in education practice (with traditional and/or online adult education). Two unique
examples are the use of simulation exercises in combination with chaos theory (Leigh
and Spindler 2004), and computer science programming using modeling (Roussev and
Rousseva 2004), that provided ‘directive and supportive’ scope in the spirit of Rogers
‘freedom to learn’ philosophy. Experiential learning theory was effectively applied in
university courses as problem-based learning (Gilding and Martino 2001; Ul-Haq, Stiles
and Pond 2003; Duffy and Kirkley 2004; Webb, Gill and Poe 2005), and successfully in
organizational contexts (Cooke 2004; Waight and Stewart 2005b).

According to Rogers, learning is facilitated when students participate completely in the
learning process and have control over its nature and direction. This is further
augmented when learning events are primarily based upon direct confrontation with
practical, social, personal or research problems (realistic context). Also important is
self-evaluation for assessing progress or success. This theory also serves as a very good
model for adult course design, but when reviewing it I felt it did not actively promote
the cognitive development, motivational, and self-regulation aspects of learning. Also I
felt it was less applicable to professional learning since it emphasized realistic physical
and face-to-face contexts that may most applicable to advanced professional degrees
(where more time is allotted for contextual research and experimentation as compared
with the expectations associated with sporadic professional learning courses). Therefore
it may be difficult to fully apply experiential learning for online courses needed by busy
and/or mobile project managers. Nevertheless these ideas positively influenced me, and
are considered herein.

Another contemporary variation of andragogy is the adult learning theory built upon the
*Characteristics of Adults as Learners* (CAL) model (Cross 1981), which takes a
humanistic focus in terms of advocating lifelong learning programs, while also encompassing principles from both andragogy and experiential learning. The CAL model is a theoretical framework to guide learning design and evaluation. It consists of two classes of variables: personal characteristics and situational characteristics. Personal characteristics include aging, life phases, and developmental stages, each having different dimensions as far as lifelong learning is concerned. Aging results in the deterioration of certain sensory-motor abilities (e.g. eyesight, hearing, and reaction time) while intelligence abilities (e.g. decision-making skills, reasoning, vocabulary) tend to improve. Life phases and developmental stages (e.g. marriage, job changes, and retirement) involve a series of plateaus and transitions that may or may not be directly related to age. Situational (context) characteristics consist of part-time versus full-time learning, and voluntary versus compulsory learning. The administration of learning (i.e. schedules, locations, and procedures) is strongly affected by the first variable; the second pertains to the self-directed, problem-centered nature of most adult learning.

Quite honestly I didn’t test the CAL model extensively during my preliminary thesis research (as I did with andragogy and experiential learning), but during the pilots I found the variables ‘fit’ well with the learning assessment phase. However, I feel the andragogical concepts still represent better ‘core drivers’ to determine how to improve professional learning (and therefore andragogy mostly defines the variables to measure). Another reason I choose not to extensively rely on the CAL model is that it has a strong focus on the part/full-time aspect of learning, but in reality, at least for project managers, learning is always part-time due to the nature of the profession. Secondly, the CAL model emphasizes adapting to the age of participants, specifically that they may have less ability as they grow older (and possibly require less cognitively complex content), which I found did not correlate with my preliminary pilot findings, whereupon age, experience, and attitude all seemed to remain constant or improve with age, not decrease (Strang 2004a). Thirdly, and most importantly, I do not apply the distinction of compulsory versus volunteer learning, instead I focus on what I call andragogical motivation, since it has been my experience that professionals can only experience effective learning by recognizing and applying their own motivation and volition (self-regulation and self-efficacy principles address this). However I do think CAL is a useful
concept, and its variables could be used in combinations with other factors to design and/or measure outcomes in any contemporary adult learning model.

Again, an alternative view on this is applying learning styles within the professional learning context could help to understand needs, and also it could allow learners to better understand their own preferences. A significant contemporary alternative view to emphasizing self-directed professional learning is that learners may not have an affective learning style (‘personal theory’). Over-emphasizing the learning-styles notion by putting the learner in control may not be appropriate because learners don’t always know the best ways to improve their learning (Clark and Mayer 2003). A critical ideological belief to reiterate here is I find learner controlled, self-directed learning may not be effective, especially if you need to apply a learning development methodology at the university or corporate stakeholder level whereupon you need to account for a large group of clients (with diverse learning styles). Furthermore, I find that professionals are just too busy to take on the extra motivational and cognitive load of directing themselves through the whole process. They need some qualified and respectful guidance. This sentiment was highlighted earlier, referring to why CAL adult learning (p. 72) and experiential learning theory (p. 71), are not seen as the better approaches for professional learning (although they are certainly better than pedagogy alone). The reason for this relates back to one of the five key andragogy principles I apply which is ‘learners need to be shown how to direct themselves through information’ (p. 71).

Many other writers contribute good ideas towards improving andragogical course design and pedagogical delivery, such as Hung’s proposition (which is similar to this research view) to integrate behaviorist, cognitivist, social/constructivist learning principles (his article includes excellent theory comparisons), which he summarizes as "instead of regarding the different learning theories as discordant, we rather adopt the instructional approaches derived from each of the learning theories and situate them in the appropriate instructional context based on the learning objectives” (Hung 2001, p. 7).
Robson for example reminds us of the importance in balancing the human-technology interface for adult-centered course design and delivery, which is founded on sound educational theory. The high-tech/high-touch balancing in goal-based course design requires “...student cognition, attitudes, interaction, access to knowledge and individualization” (Robson 2002, p.1), and in particular she argues for improved evaluation to compliment this, which certainly subscribes to the rationale discussed earlier for addressing the needs of two key stakeholders - the student and the organization offering the course (as well as indirectly benefiting the instructor through relevant constructive feedback). This propounds an underlying philosophy of contextual balancing and accommodation from the earlier discussions of Piaget’s equilibration theory (Piaget 1952).

Alternative propositions in the literature (see: Czubaj 2000; Illeris 2003) illustrate how macro-level ideologies can impact adult-centered learning theory, such as general systems theory (a systemic view of interrelated and interacting components – curriculum and content - working together toward a common outcome), communications (how knowledge is transferred and interpreted), and instructional psychology from prominent theorists such as Brunner, Gagné, Merrill, Mager, and Dick (which advocate learning goals must map to specific events in learning processes).

2.6. Applied Learning Context Design Frameworks & Methodologies
The previous subsections explained relevant learning theory from a meta-theoretical (broad) aspect, then proceeded toward an individual level of analysis. The review of principles was positioned from a ‘learner as the key stakeholder’ basis. From these previous sections we can conclude that many if not all these principles from multiple disciplines could improve professional learning. Again the educational philosophy applied in this thesis is that humanistic adult-centered approaches are considered pivotal, and the ‘manner’, not the content, design, or context per se, is most important. This is the reason the chapter began with the review of contemporary and fundamental adult-centered learning principles, as well as formal theories - now we examine context.

The point of this section is to suggest how these principles can be methodically applied in an appropriate manner to improve the context design of the adult learning experience.
The emphasis remains on the learner, but now the focus shifts to the instructional context design process (and to some degree, towards the organization as the stakeholder). The question becomes how all resources in the stakeholder model (Figure 2.2), and educational psychology principles (Figure 2.1 and Figure 2.3), can be synergistically harnessed, as a methodology, to improve professional learning. The main antithesis (rival) to this approach is self-directed learning (examined earlier).

The formal course design and instruction methodologies are far fewer than the adult-centered theories and principles discussed earlier (Table 2.1, Table 2.2, Table 2.3, Table 2.4). Two mainstream methodologies – Bloom’s Educational Goals and Gagné’s Conditionals of Learning - have influenced the preliminary and thesis research. These two formal frameworks have leveraged many of the aforementioned adult-learning concepts, and they also apply other theories, the latter of which (the relevant elements) are briefly discussed below. Cognitive Apprenticeships was explored in earlier research but was not further applied in this thesis due to the lack of professional PM mentors available, and also of course, due to the economies-of-scale constraints with such a mentor-intensive online instructional model. Furthermore, as noted at the start of the chapter, many researchers noted it was mainly the ‘how’ of instructional delivery, and not so much the content or structure of the online courses, that resulted in the highest adult learner satisfaction and performance levels in recent empirical studies. Nevertheless, many of the relevant methodologies are briefly defined in this section.

2.6.1. Learning Context Design Frameworks

Several writers have documented learning design and instruction frameworks that have stood the test of time and practice. Although these frameworks were often meant for face-to-face modes, and high school stakeholders, their structures are valid applications of the educational psychology principles and theories discussed in previous sections. The most well known traditional learning context design framework resulted from the collaboration of several authors in association with the 1948 Convention of the American Psychological Association, (led by Bloom) to formulate a taxonomy of "the goals of the educational process", which consisted of three overlapping educational psychology domains: cognitive, psychomotor, and affective (Gronlund 1970; Anderson...
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and Krathwohl 2001). This is such a comprehensive and influential context design theory that I have summarized its principles in Table 2.5 and I critically analyze it.

*Table 2.5: Educational Goals Taxonomy*

<table>
<thead>
<tr>
<th>Educational Domain</th>
<th>Typical Learning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Knowledge</td>
<td>Arrange, define, duplicate, label, list, memorize, name, order, recognize, reproduce state.</td>
</tr>
<tr>
<td>2. Comprehension</td>
<td>Classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate,</td>
</tr>
<tr>
<td>3. Application</td>
<td>Apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.</td>
</tr>
<tr>
<td>4. Analysis</td>
<td>Analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.</td>
</tr>
<tr>
<td>5. Synthesis</td>
<td>Arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up, write.</td>
</tr>
<tr>
<td>6. Evaluation</td>
<td>Appraise, argue, assess, attach, choose compare, defend estimate, judge, predict, rate, core, select, support, value, evaluate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cognitive Learning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Receiving</td>
<td>Be aware of a situation, be willing to receive it, and attend to it.</td>
</tr>
<tr>
<td>2. Responding</td>
<td>To go along with a situation, be willing to respond, and to be satisfied with the situation.</td>
</tr>
<tr>
<td>3. Valuing</td>
<td>To accept a value, to support a value, and to commit oneself to it.</td>
</tr>
<tr>
<td>4. Organizing</td>
<td>To conceptualize the value and to have an organized value system.</td>
</tr>
<tr>
<td>5. Characterizing</td>
<td>To have a generalized set of values which represent yourself.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Affective Attitude</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reflex</td>
<td>Biological conditioning (objectives not usually written at this &quot;low&quot; level),</td>
</tr>
<tr>
<td>2. Fundamental</td>
<td>Classical conditioning applicable mostly to young children: crawl, run, jump, reach, change direction</td>
</tr>
<tr>
<td>3. Perceptual</td>
<td>Higher-order coordination: catch, write, balance, distinguish, manipulate abilities</td>
</tr>
<tr>
<td>4. Physical abilities</td>
<td>Stop, increase, move quickly, change, react</td>
</tr>
<tr>
<td>5. Skilled</td>
<td>Play, hit, swim, dive, use</td>
</tr>
<tr>
<td>6. Non-discursive</td>
<td>Express, create, mime, design, interpret</td>
</tr>
</tbody>
</table>

Psychomotor

In the *educational goals taxonomy* (Bloom and Krathwohl 1956) the *cognitive learning domain* consists of six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. For each level, specific learning behaviors were defined as well as appropriate descriptive verbs that could be used for writing instructional
objectives. The *affective domain* (Krathwohl, Bloom and Masia 1964) consisted of behaviors corresponding to: attitudes of awareness, interest, attention, concern, and responsibility, ability to listen and respond in interactions with others, and ability to demonstrate those attitudinal characteristics or values which are appropriate to the test situation and the field of study.

The domains relate to the humanistic principles discussed earlier, such as emotions, attitudes, appreciations, and values (enjoying, conserving, respecting, and supporting). This work was later extended to include the sensory-motor (biological and behavioral theories discussed earlier) *psychomotor domain* and this became adapted into the model (Harrow 1972). The psychomotor domain contained six levels: reflex, fundamental movements, perceptual abilities, physical abilities, skilled movements, and non-discursive communication - but this third domain is not related to this thesis.

The significance of the *educational goals taxonomy* for professional learning is that it is still relevant. As discussed above it applies the educational psychology principles and theories, and it promotes goal-directed learning since it lists concrete measures for identifying different levels of learning which are linked to the instructional objectives and the systematic design of the instructional programs. This taxonomy is also encompassed within instructional design models discussed later (Gagné, Merrill, and Mager). Bloom’s taxonomy was later supplemented by the *Structure of the Observed Learning Outcome* (SOLO) taxonomy (Biggs 1995) that focused on the performance aspect, classifying them into five classes: prestructural (too simple), unistructural (one aspect employed), multistructural (not integrated), relational (integrated, acceptable), and fifthly the extended abstract (excellent, generalized to a higher level and/or new topic).

The *cognitive apprenticeship learning model* (Brown, Collins and Duguid 1989; Collins, Brown and Newman 1989) integrates the situated learning and the expert-novice apprenticeship theories to develop the cognitive apprenticeships learning model. Their idea is actually a framework for course and instructional design. What is interesting and relevant here is their framework integrates not only the principles for
cognitive development discussed earlier, but they also provide guidance for organizing the knowledge and sequencing the processes. It is referred to as the ‘characteristics of ideal learning environments’, with categories of content, methods, sequence and sociology, each of which contain additional sub-categories.

The potential applicability of the cognitive apprenticeship learning model for professional learning is that it holistically applies many of the humanistic, behavioral, constructivist, and cognitive development principles discussed earlier. However, the above set of ‘learning goals’ are apparently meant to provide a set of tools, rather than a prescriptive model, therefore it is another guideline to consider for course design. Another interesting finding in the literature is that this framework seems to rely on having an expert able to explain the cognitive learning strategies, relatively small class sizes, and a great deal of interaction between teacher and learner (Speelman 1998), all of which may not be practical for a busy project manager - or instructor.

The Model-centered instruction (MCI) (Gibbons and Fairweather 1998) is a very good framework of principles for course designers to use in selecting and arranging online design constructs. It maintains designs that originate and maintain the priority of ‘model’ as the central design structure (and therefore may not be learner focused). MCI is accompanied by a computer science systems methodology to assist in designing the course. The methodology is called the Model-Centered Analysis Process (MCAP) and its purpose is to identify the elements of all three models, and relate them directly to problems. This methodology is designed to automatically unite the specification of the learning environments, instructional methods, presentation, and knowledge structures.

The MCI methodology and framework is focused on content layout and presentation (with focus on interaction capabilities with the learner), and is particularly suitable for building online (Internet-delivered) instruction. However, this model (and other software development methodologies) are not suitable for the underlying purposes here, being that we want to build a method to improve professional learning, yet they may be helpful in the means to achieve those ends (and to share with the reader).
An interesting contemporary constructivist-oriented learning design framework is known as MAR (a metaphor representing ´mind as rhizome´). The meaning of the name refers to constantly shifting structure without fixed points or hierarchy), which uses ´the problem as a stimulus for authentic activity´ (Duffy and Cunningham 1996, p. 190). The concept is similar to what I have proposed in the learning goal model, in that instead of ´teaching´, the teacher/facilitator supports the student’s learning as skills are developed through working on the problem (the authentic activity). It also applies much of the same principles of problem-based-learning and utilizes a framework of elements like the cognitive apprenticeship model discussed above (thus the content is not repeated here).

It is accepted here (in agreement with the MAR concept) that discovery learning, mastery learning, knowledge scaffolding, cognitive apprenticeships, coaching and collaborative learning, are all useful for professional learning. These principles are frequently referred to as constructivist methods in the literature, but they are only truly constructivist to the extent that they are used not to teach students ´what´ they "should do/know and when they should do/know it", but rather to "support the students in developing their critical thinking skills, self-directed learning skills, and content knowledge in relation to the problem" (p. 191). To this extent the MAR concept is a bit too self-directed in nature as compared with the aims of a generalized needs approach.

### 2.6.2. Learning Context Design Systemic Methodologies

There are a number of systemic instructional design models that borrow from the principles of behavioral, humanistic, cognitive, social, and constructivist ideology (Gustafson and Powell 1991). While all of these systemic models make unique and important contributions to instructional design theory and practice, they are similar enough that a relatively detailed discussion of one or two will serve the purposes here. Two of the mainstream systemic methodologies are discussed below (the second one is later adapted for this thesis); the remaining paragraphs briefly explain rival concepts.

The term ´systemic model´ as it would apply to educational psychology is best defined by a practitioner, with a good example being "a set of interrelated parts, all of
which work together toward a defined goal” (Dick and Carey 1996, p. 3), which in this case would be a model for instruction includes all the relevant educational psychology theories and context design best-practices, to produce an end result of high professional learner performance and satisfaction level. Systemic models differ from the contextual frameworks discussed above in that the former (as explained below) are more elaborate (with quality assurance/feedback checks) and they are sequence oriented. The context activities vary from model to model, from methodology to methodology, depending on the specific situation in which the systemic model is to be applied, and the specific assumptions about learning that underpin the model. However, at the heart of these models are several common processes, including some sort of front-end analysis to find out about contextual factors and goals, a process for creating materials or instruction, and a feedback/evaluation mechanism to determine if the process is working. For example, a systemic methodology often will apply adult-centered (or other) theories, and it may include design goals from the contextual framework taxonomies described earlier. Systemic methodologies apply a project management governance to the educational context design process (and often include delivery and assessment phases).

The Dick and Carey Systems Approach Model for Designing Instruction (Dick and Carey 1996) is commonly the mainstream systemic model and is used as a representative instructional design methodology. It is also used for teaching instructional design to novice instructional designers (as a cognitive apprenticeship application). Dick and Carey's model includes nine related processes, which, under simple or uncomplicated circumstances, might proceed somewhat linearly. Those processes are:

1) Determine instructional goal,
2) Analyze the instructional goal,
3) Analyze learners and contexts, write performance objectives,
4) Develop assessment instruments,
5) Develop instructional strategy,
6) Develop and select instruction,
7) Design and conduct the formative evaluations (constructive feedback),
8) Revise instruction, and
9) Conduct summative (formal, quantitative marking) evaluations.

It must be remembered, however, that, because the model is systemic, all related parts "work together" and the order and frequency of their performance is dictated by the particular context of the learning problem being addressed. Dick and Carey promote their model as being appropriate for use by instructional designers, instructors, public school teachers, university professors, industrial trainers, and military instructors. Like most of the instructional design models I am using it to represent, it is designed to be applicable for a wide variety of learning tasks and in a variety of situations. This model is definitely a project management activity list, at least from a high level perspective. The difference is, it does not specify the content development framework (such as the earlier section discussed), nor does it describe a methodology for conducting the above activities. Instead, it would rely on previous methodologies (as well as project management) to complete and deliver professional learning, in an ongoing manner.

Gagné’s *Conditions of Learning theory* contains a framework of items necessary to consider during the design process. It is also a systemic methodology for learning instruction and evaluation. The design activity is guided by pre-requisite skills and the level of cognitive processing involved. The *Principles of Instructional Design* (Gagné, Briggs and Wager 1992) is a methodology (with project management activity lists) to design and delivery education. According to Gagné et al. (1992), there are five kinds of learned capacities: intellectual skills, cognitive strategies, verbal information, motor skill, and attitude. The *conditions of learning* process is almost identical to the Dick & Carey methodology, which according to Gagné uses the following procedures:

1) Define performance objectives,
2) Analyze the overall learning task,
3) Design instructional sequences and learning events,
4) Select appropriate media,
5) Design the individual lessons,
6) Assess the instruction;

(Gagné, Briggs and Wager 1992).
Gagné also specifies instructional approaches associated with each learning phase, which apply humanistic theories of motivation, expectancy, and perception, along with cognitive processing concepts. At the start of learning he points out attending and expectancy goal setting are required. Next retrieval is used during the learning process to establish the cognitive baseline, which is followed by selective perception and semantic encoding to cognitively learn the material. Retrieval and responding are applied to build long-term schemata, which is further assisted with reinforcement and cueing (such as using quizzes). Probably the most important element in his learning phases is the generalizability aspect that is related to conceptual understanding, thus promoting real learning in terms of how the knowledge can be applied to new contexts.

I have applied Gagné’s instructional approaches during course design (Strang 2004a, 2004b), but I find it does not contain the critical self-regulation and self-efficacy theories. Despite its limitations, and since this is a very popular and effective methodology, in this thesis I transformed Gagné’s model to encompass the critical elements which I perceived were necessary for professional learning. As Figure 2.6 shows, the major elements I added (heavier dashed arrows) include the systemic feedback mechanisms to build self-efficacy, support self-regulation, as well as mastery learning goal focus. I have also shown several of the principles I used during the action science pilot experiences. This model also embraces systems thinking and triple-loop (generative) learning principles, in the sense that it recommends critical self reflection, meta-cognition, to think beyond-the-box, while using constructive feedback from both instructor and peers.

The key difference in this adapted version of the model (towards support of the thesis vision), is the explicit embracing of the andragogical motivation, self-efficacy, self-regulation, and self-schema, as shown with the embellishments in Figure 2.6. Another strategic meta-learning improvement in this adaptation is that it subscribes to the organizational level of analysis, as opposed to just a course. By this I mean that if the model is applied as I suggest here, an instructor and/or design team would reflect on the post-course assessments (as a shared knowledge creation/sharing social process), review
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current (developing) theories along with stakeholder needs analysis, and improve the course for iterative cycles. This is the organizational triple-loop learning (systemic) nature of this enhanced model. An advantage of this model is colleagues readily understood and condoned its use for online course delivery (Strang 2004a, 2004b).

Figure 2.6: Professional Learning Instruction Process Design Systemic Model

A contemporary alternative to the two mainstream systemic learning context design methodologies described above is the Criterion Referenced Instruction (Mager 1997). The CRI is similar to the above methodologies, but differs in that it allows the learner the freedom to choose their own learning sequence based upon mastery of pre-requisite lessons. This is a modification to the behavioral programmed instruction (e.g. Skinner 1974) discussed earlier, and also an application of mastery goals principles (e.g. Keller and Sherman 1974). The Component Display Theory (Merrill and Group 1996) applies self-directed learning principles (Hiemstra and Brockett 1994) in that it proposes that the learners select their own learning sequence based upon the instructional components available. They define a learning concept as a set of specific objects, symbols, or events which are grouped together on the basis of shared characteristics and which can be
referenced by a particular name and symbol (Merrill and Tennyson 1977; Merrill and Group 1996). Merrill and Tennyson’s model for teaching concepts continues in like manner, through careful definition of strategies for teaching, to identifying relationships between concepts, to stages of evaluation. In terms of the thesis, the aim is for economies-of-scale, generalizable models, since (as argued earlier) it would not be practical or economical to recommend individualizing the professional learning approach, where the aim is to advance the global PM profession via online learning.

2.6.3. Synopsis of Context Design Frameworks & Methodologies

The apprenticeship and GMCAID approaches include principles of situated cognition as a guideline for instructional design context settings. The MCI and MCAP methodology are very comprehensive procedures to guide a technology project aimed at moving a good professional learning course online, and as such, the recommendation is it could be used for just that. The learning goal orientation of MCI is also very promising. MAR is a combination of framework and project development methodology that heavily borrows the principle elements from the cognitive apprenticeship model. However, all of these lack support of the humanistic adult-centered principles.

The educational learning goals taxonomy is well known, and widely applied, in educational psychology, particularly in high school and vocational training programs. The model does apply many of the important humanistic, cognitive, and behavioral principles discussed earlier, albeit it does also rely (1/3 of it) on the psychomotor ideology. A benefit of knowing this model is that many professionals (and their superordinates) are familiar with it, and to a degree may expect its principles to be encompassed in learning programs. Therefore in designing courses for professionals, it may be wise to address this either in content and/or disclaimer (the latter if the model is not used at all).

In my experience I found it useful to know several of the mainstream meta-theories as well as context design methodologies because this allowed me to appreciate the perspective of other instructors/design teams, and even more importantly, it allowed me to reflect on the generalized learning context expectations of my adult students. Another
benefit in knowing the systemic methodologies is that often older programs are upgraded or transformed to online delivery, and thus, knowing the original model allows one to transfer its intention and critical content into another framework methodology, and often the transformation is from a face-to-face into an online context.

The cognitive apprenticeship model is probably more oriented toward the continuous learning needs of professional project managers, since it applies the complex cognitive development, humanistic, and social learning principles to improve developing expertise. The principles of the cognitive apprenticeship model were successfully used in pilots, namely: scaffolding (providing a framework for conceptual learning through cues and discussion forum guidance), as well as and reflective learning (via the assignment requirements). It was difficult however during the pilots to obtain the needed experts to share their knowledge and spend time with the professional novices. Additionally, it was difficult to make the learning experiences realistic. Nevertheless, one feature which did work well in the pilots was role-playing wherein I took on the role of their boss, board director, etc., during their presentations, to give them an appreciation of what they may experience in the actual work environment. Additionally, the students took on these supervisory and expert roles in certain situations, as they provided feedback during peer presentations. According to student feedback, using contemporary articles and videos along with the course work provided a good appreciation of the realistic context where the theory is applied, and thus in their opinions (and mine) improved the conceptual learning.

2.6.4. Best-Practices in Learning Context Design

Overall, the frameworks and methodologies discussed in this section offer effective learning context design frameworks (as theoretical blueprints) and governance (as a design and delivery evaluation process). As implied in these earlier discussions, the mainstream methodologies evolved mostly from behavioristic ideologies and are empirically replicated at the school level. It was argued they do not offer the best structure for designing and delivering the professional PM learning vision. Yet with adaptation, three theories were transformed into an instructional design systemic model.
The previous discussions have all touched upon various ‘aspects’ of theory and method for improving the framework, context, content, and process of learning design, which themselves borrowed from the educational psychological ideologies discussed earlier. In fact, some of the frameworks and processes discussed in the last section were comprehensive methodologies for designing a professional learning framework. However, in one way or another, the methodologies reviewed in this section provide a more general overview of the systemic models for the end-to-end of instructional design, which also encompass some or all of the aspects from the psychoanalytic, humanistic, constructivist, and contextual social developmental schools of educational psychology though. While the mainstream frameworks (such as Bloom’s and Gagné’s) offer a good knowledge structure for context design, they are not systemic as they do not encompass a complete end-to-end process with feedback, and they do not reveal the stakeholders (‘actors’ in systems design terminology). The section below addresses this limitation by adapting the original model using multiple theories and principles.

The model in Figure 2.7 shows a professional learning context design model adapted from formal andragogical theory as well as informed by constructivist principles. The model illustrates how andragogical, constructivist, behaviorist, humanistic, and cognitive development principles, were successfully applied to learning context design in the preliminary research (Strang 2004b; Strang 2004a; Strang 2005a; 2005c; 2005f).

The significant aspect of this proposed model is the interaction of the principles (explained earlier in Table 2.1, Table 2.2, Table 2.3, and Table 2.4) within the learning context, along with the systemic (immediate as well as triple-loop) design feedback processes (described in Figure 2.4) that engage all stakeholders and resources during the life cycle (as advocated earlier in Figure 2.1, Figure 2.2, and Figure 2.3).
Instructor formative, normative & summative assessments & debriefs

Reflection & self-awareness

Peer dialogue, self-reflection, peer feedback

Stakeholder ownership in learning process

Goal setting, theory assessments (flexible pace, open-book exams, online presentations, group projects)

Figure 2.7: Professional Learning Context Design Systemic Model

This model was designed by applying some of Gagné and Disk’s approach (explained earlier), and I integrated the contemporary ‘Seven Goals” concept (adapted from: Honebein 1996). In keeping with the holistic and contextual approach, I added the principles of social cognitive development, whereby I refer to Ford’s whole person (stakeholder) view of learning (Ford 1992). The starting point shown in this process flow model (Figure 2.7), from the learner perspective, is “Knowledge construction”, while the context design emphasis begins at the center-most ‘Constructivist learning and andragogical learning” and then extends outwards.

2.7. Synthesized Applied Professional Learning Principles

This research was informed by contemporary and relevant andragogical learning literature, and it was driven by action research using course pilots in the preliminary thesis research phase. The literature and pilots confirmed the importance of self-efficacy, self-regulation, cognitive self-schema development, along with the underlying andragogical motivation and goal setting mechanisms (Strang 2004a; Strang 2005c; 2005f). In the field studies, it was not necessarily the quantity of instructor involvement
or knowledge provided, but the quality, timing and how it was provided which accounted for the success, and also explained earlier failures.

Figure 2.8 illustrates the applied professional learning principles based on everything else already discussed in this chapter. This integrative model was originally developed as a theoretical concept during the literature review of preliminary research. It was explained and tested in other research (see: Strang 2004b, p. 16; Strang 2004a; Strang 2005c; 2005f). Since it has been described previously, the refined version is included here (instead of earlier in this chapter), to convey it as a synopsis of the key adult-centered professional learning context design and delivery principles.

This synthesized online professional learning approach argues that course design should be informed by the combinations of principles proposed therein. The main principles of the model which accommodate professional learning are those which revolve around andragogical motivation, self-regulation, efficacy development, and self-schema (cognitive development within individual and social contexts). Firstly, this is achieved by establishing a clear vision (learning objectives), providing knowledge scaffolding (digital lectures/content) and sequencing (outlines), then by reinforcing and transferring knowledge (assessed by scheduled multiple choice and essay tests). Secondly, flexibility was included in the process and methods using individual or group oriented problem-based approaches (critical and reflective learning). Multiple personality and learning styles (cognitive, kinetic, etc.) were appeased through flexibility and strengthened by motivation.
Instructional Approach

Intervening variables:
- Learner effort & knowledge
- Task clarity & learner skills
- Institutional/instructor support
- Self-regulation
- Self-schemas
- Resources/support services
- External coordination

Outcomes:
- Mastery Learning
- Self-efficacy

Information Provision,
- Basic skills practice,
- Strengthening connections,
- Stimuli-response
- Associations,
- Motivation/Achievement

Information processing,
- Knowledge sharing,
- Programmed instruction,
- Survey-Question
- Read-Recite-Review & Reflect

Learning to Learn,
- Learning Goal Theory,
- Expectancy value, Efficacy,
- Success/fear probability,
- Belief Organizing, Integrating,
- Elaborating, Reflecting

Contextual, constructivist adaptive learning

Direct short-term impacts

Direct medium-term knowledge transfer

Indirect long-term concept learning & sense making

Figure 2.8: Synthesized Professional Learning Principles Model

The Figure 2.8: Synthesized Professional Learning Principles Model compliments not replaces the adapted models shown earlier in Figure 2.4, Figure 2.6, and Figure 2.7. The key humanistic principles driving the professional learning vision (self-efficacy, motivation, self-regulation, and self-schema) were analyzed in Figure 2.4: Systemic Model of Self-Regulation, Self-Efficacy, Goal-Setting. Recall from previous discussions that Figure 2.6: Professional Learning Instruction Process Design Systemic Model adapted Gagné’s learning goal theories by adding andragogical motivation, self-efficacy, self-regulation, and self-schema, along with an organizational triple-loop learning (systemic feedback processes). As explained earlier, Figure 2.7: Professional Learning Context Design Systemic Model was designed by applying some of Gagné and Dick’s approach, while integrating Honebein’s “Seven Goals” and Ford’s “whole person” stakeholder concepts. These three key models (Figure 2.4, Figure 2.6, and Figure 2.7) inform the principles leading to this Figure 2.8: Synthesized Professional Learning Principles Model. They should all be used together.
2.7.1. Experimental Model

Now the literature review and theory building is complete and several models have been developed. The last model (Figure 2.8) presented the overall synthesis of the approach. The next step is to determine how these models and approaches can be scientifically tested at a university. To implement this, we need a configuration that lends itself to quantitative and/or qualitative measurement. As will be discussed very intensively in the next chapter, a rigorous quasi-experimental repeated-measures design will be used.

The following diagram (Figure 2.9) shows an experimental factor model as a ‘transformed’ version of the adult-centered theories (derived from Figure 2.4, Figure 2.6, Figure 2.7, and Figure 2.8). This model shows the professional learning approach itself as a ‘black box’ process that combines the relevant principles discussed previously: andragogical motivation, self-regulation, self-efficacy, and self-schema cognitive development (implied as part of the learning goal components).

Figure 2.9: Professional Learning Goal Experimental Factor Model

This professional learning goal approach is impacted by other elements in the environment, such as the key ones shown in the diagram: culture, experience, age,
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gender, prior knowledge, and the social learning context. These are the independent factors - those elements that a mentor or instructor cannot control, but they still must be aware of. Since it is scientifically impossible to account for all possible contextual factors that may impact the professional learning of project managers, the ‘Other Factors’ is identified to acknowledge this. There are many outcome variables in the professional learning process, such as happiness/sadness, good marks, knowledge transfer, and so on. The two dependent variables of ‘Performance/GPV score’ and ‘satisfaction’ are aggregate metrics (at the individual level of analysis) to represent the cumulative quantitative and qualitative outcomes, respectively. This model will serve as the systemic baseline for empirically testing its effectiveness in the experiments (discussed in the next chapter).

In part, this experimental model (the independent factors and dependent outcome variables), was influenced by empirical studies and theoretical models from the literature (specifically: Grandzol 2004; McAlpine 2004; Rungtusanatham, Ellram, Sieferd et al. 2004; Arbaugh 2005b; Arbaugh 2005a; Crick and Wilson 2005; DiMaria-Ghalili, Ostrow and Rodney 2005; Kirkpatrick 2005; Maclellan 2005; Moon, Birchall, Williams et al. 2005; Muir 2005; Tynjala and Hakkinen 2005; Waight and Stewart 2005b).

The major influence on the outcome variables of GPV and satisfaction came from previous experience and the existing course assessment mechanisms, in place at the universities where these experiments have (in the past) and will take place (in the future). This is opportunistic rather than purely rationalistic. Yet it needs to be emphasized that given the aim of this thesis to advance the PM profession through better course design and delivery methods, using a familiar and proven (university stakeholder) learning assessment device will be a definite advantage and very practical. Chapter 3 will elaborate in detail on how this factor model will be tested in experiments.
2.8. Chapter Summary

First the chapter started with an examination of current best-practices to identify the gaps in online professional (adult-centered) learning design and delivery. Interesting research was highlighted with the conclusion that there was no conclusive approach. The chapter introduced an epistemological framework (Figure 2.1) that was used to guide the literature review. An important philosophical standpoint taken by the author was to place the learner in the focus of the research, as the key stakeholder (Figure 2.2).

The historical review of meta-theoretical learning ideologies (Figure 2.3) covered the main schools of thought from the humanistic perspective, behaviorism movement, and constructivist paradigm. The fundamental principles were integrated into a synthesis of educational psychology meta-theories. The chapter included learning theory definitions, relevant principles (synthesized by four educational psychology ideologies in Table 2.1, Table 2.2, Table 2.3, Table 2.4), and a discussion of formal adult learning theories.

The main point of the humanistic-constructivist ideology was the adapted model of self-regulation, self-efficacy, and goal-setting (Figure 2.4). The last major chapter section discussed learning context design, instructional approaches, and systemic methodologies. Several taxonomies and frameworks were listed (see Table 2.5 for the most popular and well-known one), then a diagram was shown to illustrate how the key educational psychology theories have been integrated and adapted to support this professional learning goal approach (Figure 2.5).

The chapter culminated with two key professional learning models, the first was an instructional goal approach from a delivery point of view (Figure 2.6), and the second a context design paradigm from a professional-learner standpoint (Figure 2.7). The literature review and theory building closed by presenting the important ‘overall’ theoretical professional learning model informed from this thesis research (Figure 2.8). The theoretical model (Figure 2.8) was converted into an experimental factor model using hypothesized cause/effect factors and variables (Figure 2.9) and this will now be tested in the upcoming chapters. The next chapter will discuss the testing methodology, which will be followed by the results of the quasi-experiment, and the implications.
3. RESEARCH METHODOLOGY

This chapter explains the strategies and techniques used to investigate the research questions, starting with the logical approach, then defining the research framework, concluding with the appropriate hypotheses-testing and risk mitigation procedures. A unique direction taken in writing this chapter is to explain how some of the educational psychology theories (from Chapter 2) have been integrated with project management concepts, to formulate a philosophy, governance and methodology to guide this thesis.

3.1. Methodology Underlying the Applied Methodology

The approach to identifying the appropriate research methodology itself paradoxically requires a process, which is already defined in the academic and scientific literature.

Strategically, the primary facets studied within and supported by the paradigm of the research epistemology are actually leveraged in this process to frame and enumerate a means-ends conceptualization of the applied thesis methodology. By this I mean that stakeholder management, leadership, and project management, provide guidance to negotiate a shared vision, scope, and sequenced-path toward the desired end objectives; critical thinking, cognitive reasoning and systems theories from knowledge management underpin the philosophical foundations to articulate and interpret the research; while various management and social science disciplines (particularly organizational learning and educational psychology) inform the meta-theoretical content of the studies. To a great extent these paradigms overlap in most aspects of this longitudinal\(^5\) work. Figure 3.1 illustrates a conceptualization of the overall theory-building research infrastructure.

The literature furnishes the generally accepted processes and ethics for applying scientific methods (such as the multi-method approach and statistical testing) to explain the epistemological\(^6\), enumerate the metaphysical\(^7\), and analyze the ontological\(^8\) aspects

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\(^5\) Longitudinal is used here to describe the development of persons or groups over time, such as a longitudinal study of leaders or project managers Ibid..

\(^6\) The term “epistemological” is from the field of philosophy and refers to the nature of knowledge, its presuppositions and foundations, and its extent and validity Ibid..

\(^7\) Metaphysical can be described as an abstract or theoretical view based on speculative or abstract reasoning Ibid..
of the explorations. The application of real life research experience and intuition, described by critical thinking writers as ‘knowing in action’ (Schön 1983) and ‘self-transcending’ tacit knowledge creation (Scharmer 2001), is also a source of expertise.

![Diagram of Theory-Building Research Infrastructure]

Figure 3.1: Theory-Building Research Infrastructure

From a reflective perspective, selecting the research methodologies required matching the needs with the appropriate methods already documented in the literature. The theory-building research infrastructure was thereby designed by applying the appropriate paradigm chartered by the research community. Previous education and experience also generated competencies in research skills and statistical analysis. Specifically this was an (honors-level) Fellow Life Management Institute (a designation awarded by Life Office Management Association of USA, whereby the concentration was in life/health insurance actuarial mathematics, pension investment funding, and systems theory). Additional research experience came from the work of an MBA from Birmingham University (also honors-level).

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8 Ontological is a more detailed metaphysical term used here as relating to reality, the essence or the nature of being Ibid..
In addition to determining how to select the appropriate methodology, one must embrace a philosophical viewpoint for perceiving and explaining the epistemology, developing the research questions, and interpreting the analysis. Next a research paradigm is constructed to govern the process and methodology used to conduct and analyze the work, which can be decomposed into a theoretical articulation component, and a theoretical testing approach. Finally the content and results of the evaluations are cultivated within a generally accepted research frame (subjects, data, measures, tests).

### 3.1.1. Philosophical Foundations

Given that philosophy is a pursuit of wisdom by intellectual means through the investigation of the nature, causes, principles of reality, knowledge, and values, based on logical reasoning (Houghton-Mifflin 1994) rather than empirical methods; and given that the aim here is to develop and test a learning model for improving project management; a critical analysis of rational beliefs must be augmented by pragmatic observation of theoretical models in practice, such as using ethnography backed by scientific and statistical testing, to ensure these ideas could actually work. Figure 3.2 is an abstract of this synthesized philosophical research perspective and methodology.

This diagram shows the balanced empirical/rational researcher philosophical views for understanding and communicating theory impacting the outer meta-layers. The axiological and pragmatic approaches for explaining and testing theories are positioned within the outer layer. Multi-method procedures loosely summarized as an iterative progression through theorizing, researching, action science learning, model building, experimenting, evaluating, and theory/model adaptation, are situated on the innermost layer. The main objective of the methodology is the center-most zone, which describes the outcome as leading to a “justified true” version of a professional project.

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9 Paradigm is a key term used in this thesis as a way to articulate my set of assumptions, concepts, values, and practices that convey a way of viewing reality, accepted by the academic research community.

10 Pragmatic and pragmatism are used to mean studying behavior cause and effect in a factual sense.

11 I use the terms “axiological” and “axiomatic” as antonyms, referring to a scientifically proven understanding (such as through pragmatic efforts), and a self-evident conceptual belief, respectively.
manager learning model (borrowing from a contemporary view of perception upheld by knowledge management writers: Nonaka and Teece 2001; Strang 2003).

Figure 3.2: Philosophical Research Perspective and Methodology

A first step in documenting a methodology is to frame the conceptual philosophy for understanding and explaining the subject matter, which essentially ranges on a continuum from rationalism, being that fundamental knowledge is based on reason determined by rational analysis of ideas independent of empirical data, emotive attitudes, or authoritative pronouncements; to empiricism, whereby knowledge is based only on information gained from the senses (Popkin, R.H. ‘Philosophical Rationalism” in: Grolier 2002) such as through behavior observation and statistical measurement.

A further explanation about this philosophical inquiry continuum of rationalism versus empiricism will recount that contemporary literature often uses various terminologies to essentially refer to the same thing as I have explained above. For example, in the rationalistic spectrum, the term phenomenology is often used to explain a research perception basis whereby reality consists of objects and events perceived or understood in human consciousness and not of anything independent of human consciousness (meaning theories are abstract and probably difficult to observe or prove through statistical testing). A further development of this is constructivism (which I have
explained in Chapter 2, as it is grounded in educational psychology principles built into the professional learning models), which should be taken to mean here as a view similar to idealism and rationalism.

![Diagram](image_url)

**Figure 3.3: Action Learning Theory Development-Testing Cycle**

A modified action learning science procedure is used for pedagogical theory articulation and testing (shown in Figure 3.3). In this procedure a researcher participates in the experiment to test a known theory and evaluate outcomes, in a series of cycles, to improve a model (Kemmis and McTaggart 1988). This is accompanied by scientific statistical testing routines to validate cause/effect as a systemic process and to create a predictive linear mathematical equation. Action learning is also copiously and convincingly discoursed in the knowledge management literature as an innovative learning style using nomenclature such as “sense-making” (Senge 1994; Checkland 1999) and “reflection-in-action” (Schön 1983). Action learning has been used effectively in pedagogical model building research (such as: Zuber-Skerritt 1993).

### 3.1.1.1. Applied Research Paradigm

In this thesis I apply both rationalism and empiricism paradigms. Applying both these extreme ideals in the same research could confuse interpretation of the results. A rationalistic view claims that knowledge can be derived from certain a priori truths by deduction (prior to observation/experience), subsequently, the focus is on mathematics and related disciplines as providing examples of a priori truths such as models and formulas. An empiricist view on the other hand claims that for human beings there is no pure reason and that all knowledge is a posteriori (after experience) and derived from sense experience by induction.

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Both of these views are common in research studies and for my purposes they are a logical sequence from the abstract of meta-theoretical discovery to the reality testing of experiential teaching. The inductive approach begins by making observations about a set of relevant data, and then seeks to discover patterns that may point to more general theories; while the deductive approach specifies a process from identifying relevant theory, to developing hypotheses, then making observations relevant to testing the hypotheses, and finally comparing the hypotheses and observations (Babbie 1993). To reduce complexity, yet provide for creative action learning, the two approaches will be demarcated (delimited) between theory articulation and experimental testing.

Consequently, rationalism (and related disciplines of metaphysics and idealism) is used to form the basis for starting the thesis (in terms of building the meta-theoretical models), as well as for explaining the application of the model in terms of a resulting mathematical schema or systemic theory. Subsequently, in between theorizing and generalizing, experimentation is undertaken to examine cause/effect (thus applying empiricism and its related movements of positivism).

Empiricism is applied to test the conceptual and mathematical axioms in practice (working adults undertaking continuous learning) to prove its validity, with the customary understanding that the results can be generalized from the quasi-experimental field-test environment to actual global professional project management.

In a practical sense, the philosophical approach I adopt here to articulate my theoretical perception is to apply rationalism to conceptually describe the model and its propositions, while a logical positivism (insistence on clarity and rigorous argument), and empiricism ideologies, are utilized to scientifically test the emergent learning approaches by using cause-effect variable comparisons. Axiological principles from knowledge management reinforce the scientific discovery rules by prescribing that I capture as much of the independent factors and learning context as possible (including student, teacher, and university) because this view of reality argues that fact and perceived truth cannot be entirely separated from its environment, yet theory must be
proven through empirical testing to record dependent variable outcomes, and documented for the research community to examine and replicate.

The pragmatic approach has already been applied to the “Introduction” (Chapter 1) and “Theory Building” (Chapter 2), as existing models, theories, and current practices in the relevant disciplines were examined, then extended in this thesis. Chapter 2 placed emphasis on explaining relevant adult learning principles from multiple educational psychology theories, while reviewing their application in current practice, as opposed to starting with a current practice review. The reason this approach was taken was because my philosophy is the fundamental educational and social psychology principles are valid and can be transformed into an effective online model. This is outside the mainstream literature approach of first assuming that current practice should define the research scope, and consequently the reader will appreciate the research sequence is different than a traditional thesis. This emphasis on transforming fundamental adult learning theory into current context has been documented by other researchers as a transformative learning approach (Apps 1994; Taylor 1998; Mezirow 2000; Woerkon 2004; Byers 2005; Chapman 2005) and a perspective transformation in critical thinking and research (Mezirow 1991; Brookfield 1992; Mezirow 2000).

Finally, I could summarize my overarching philosophical foundation for the research approach as being strongly influenced by pragmatism in that my aim is to achieve both meaning and truth of my ideas as a function of their potential practical outcome(s). In this sense, the criterion for their truth in the long run from the academic community is agreement among peer researchers (Rosenthal, S.B. (2002) ‘Pragmatism is a Philosophical Movement’ in: Grolier 2002). Thus my rationale for documenting my assumptions, concepts, values, practices, and approaches for viewing reality, is to strive for credibility in the research community. Also my approach is to transform original perspectives (reuse theories), in a practical sense, instead of reinventing them.

3.1.1.2. Longitudinal Research Framework

The preliminary thesis research employed multiple research methods, to explore possibilities (and propositions) of developing a model to improve the global project management practice. For example, the preliminary research listed earlier included
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descriptive and basic theoretical examinations, observational and correlation reflections, single and multiple case empirical designs, and an applied quasi-experiment, to build the preliminary learning goal theoretical propositions and models underlying this thesis (for online PM course design and delivery). Each of the preliminary research publications included an explanation of their chosen methodology.

This current thesis research also applies multiple methods that include both qualitative and quantitative techniques. The reason the multi-method approach was employed here is because it is considered the best scientific research procedure (Schön 1983; Eisenhardt 1989; Sekaran 1992; Yin 1994; Zikmund 1994; Runeson and Skitmore 1999; Zechmeister, Zechmeister and Shaughnessy 2001, pp. 15 & 171-139).

3.1.2. Research Project Governance

It is probably not a surprise that a project management methodology is used here to effectively and efficiently manage the entire 4.5 year thesis effort. Speaking from past and current experience (reflection in action), it has been extremely valuable to have a rigorous project management methodology to ensure that all deliverables, activities, and resources are coordinated to achieve the goals here, which I am certain would otherwise have been a confusing journey producing much less research depth and quality.

Rather than redundantly cite common practice in this industry I will simply acknowledge that the Project Management Body of Knowledge (PMBOK: PMI 2004) is being applied at a high level to guide the overall endeavor, while scheduling software (Microsoft Project) is used to technically micromanage the tasks, deliverables, and resources (mainly myself).

Figure 3.4 depicts the overall governance I applied for managing this thesis research, which integrates and customizes concepts from the PMBOK knowledge areas and process cycle groups (PMBOK: PMI 2004), which is shown on the left and top area of the diagram. I also integrate the scientific multi-method approach (Yin 1994; Zikmund 1994; Zechmeister, Zechmeister and Shaughnessy 2001), depicted on the lower right portion of the diagram. The purpose of integrating the multi-method system for my governance was to create a structure for planning the “learning model” research, serve
as a guideline for executing the plan, and act as a quality-check for monitoring the whole endeavor. The most critical governance aspects of this research were scope and quality management (and to a lesser but significant extent the other “core functions” of time and cost). These core aspects were bounded by the thesis vision, research questions, the university ethics, and the independent thesis examination process.

In the diagram, the research approach from Figure 3.2 is superimposed at the lower right portion to signify ‘what’ was actually managed using this methodology. I used the Microsoft Project™ software to technically administer this methodology. Applying this methodology with the software generated many schedules, charts, and activity network diagrams that I believe would serve no additional value by including them here.

**Figure 3.4: Research Project Management Governance**

In meta-cognitive sense, I view the creation and application of this research governance model as an instance of my utilizing the educational psychology principles I explained in the previous chapter (as influencing my adult teaching), activated here to improve my research rigor and organization. This governance applies my own professional learning goals model in a sense, such articulating a self-schema, promoting self-regulation,
bolstering self-efficacy, as well as leveraging my own experiences-realized via the deutero (triple-loop) learning phenomena and knowledge reflection activities.

As a self-reflection, applying the project management governance was second-nature so-to-speak (knowing in action), since this is a core competency of my management consulting career, and I am also certified as an international Project Management Professional (PMP) by the Project Management Institute (PMI).

### 3.2. Integration of Preliminary and Thesis Research Approaches

As explained earlier, each of the preliminary thesis research components were building blocks which lead from broad, theoretical content improvement opportunities (the ‘what’, soft-skills knowledge), towards more focused ideas of methodological enhancement possibilities (the ‘how’, action research, continuous learning process), to envision how to improve global project management.

Specifically, the preliminary research inferred there were several opportunities for improving the global project management practice: help project managers learn more soft-skills (leadership, etc.), learn how to learn (including constructively reflect on their own traits and skill weaknesses/strengths), learn how to apply multiple soft-skills in various combinations according to the situation, and continuously learn while on the job (stay motivated while busy and/or traveling). Thus there were two paths of opportunities for improving the profession:

1. develop situational soft-skills content for training programs, and;
2. develop a systemic teaching model for improving project manager learning.

The second opportunity, developing a professional learning methodology, was therefore considered the most strategic practice improvement area to focus on for this thesis.

Figure 3.5 shows the critical thinking archetype adopted using a soft/system methodology (adapted from: Checkland 1999, p. 163) wherein I reframe my action learning paradigm into a systemic process.
3.2.1. Meta-Theoretical Research Frame

As discussed in a previous chapter, the approach started by studying meta-theoretical frameworks and models from different fields of study such as the social sciences (including psychology, sociology, organizational behavior, anthropology/culture, and philosophy/ethics). Management science (including stakeholder management), educational psychology in particular (including andragogy and pedagogy), knowledge creation/complexity theory, as well as the global project management body of
knowledge, were also reviewed to build operational definitions and preliminary propositions. Two earlier diagrams illustrated this notion (see Figure 3.2: Philosophical Research Perspective and Methodology and Figure 3.3: Action Learning Theory Development-Testing Cycle).

The focus of the meta-theoretical research was on finding underlying theories for developing a model to improve the learning methodology and context of a project manager (in support of continuous improvement), rather than on the content (albeit as noted above my earlier empirical research highlighted a definite need for more ‘soft-skills’ oriented training such as transformational leadership, knowledge creating/innovating/sharing, stakeholder management, and professional ethics).

3.2.2. Action Learning Science – Pilot Study
Several pilot studies were undertaken to build this preliminary andragogical and pedagogical theoretical model (with an underlying goal to improve the learning context for project managers). The subjects were project manager and professional management –level volunteers, full or part-time employed, aged 21-45, balanced genders, moderately experienced (2-17 years) and most of them were also working in the project management profession. The pilots involved online (Internet-based) programs varying from 7-22 weeks. Qualitative results from this research indicated support for the proposition that learning goal and contextual development theories increased the satisfaction of the project managers in their learning of knowledge and skills, and participant comments revealed strong self-efficacy (Strang 2004a). Quantitative results (good performance scores achieved on learning tests) also supported this proposition (ibid.). Ancillary materials from the pre-thesis pilots, and preliminary the action research models, are available from the university research register. Appendix 1 is the research ethics approvals, Appendix 2 is the survey instrument, Appendix 3 is the experiment source data.

3.2.3. Rationale for this Quasi-Experiment Study
Chapter 1 cited there is a lack of recent new andragogical theory aims at improving professional learning (especially online modes), that is also substantiated by empirical studies. This research tries to build and validate a flexible professional learning goal
model. A thesis affords the space to explain the principles from literature, build the logical model, then execute an experiment to validate its propositions. Furthermore, following the credible scientific and multi-method approach, this research extends earlier pilot findings, by showing how the model can function in a relevant adult (graduate-level) commercial learning context, where it is likely that most professionals will go to satisfy at least some of their needs for continuous education. As such, this research experiment will attempt to prove to fellow teachers and academics that humanistic underpinnings of the professional learning goal model are valid to consider in their own course design, delivery, and future research. As will be explained below, existing courses offer a convenient yet credible (natural selection) for this quasi-experiment. An underlying assumption is that andragogy and the professional learning goal principles are considered valid for both face-to-face as well as online courses. Therefore this learning model is considered valid for either mode of adult teaching, albeit my current experiments are done with online delivery.

3.3. Experiment Research Design and Infrastructure

As discussed, this research employed a multi-method research paradigm, a longitudinal, quasi-experimental, multiple case design with repeated measures of equivalent dependent variables (on the same students across courses).

Scientific experimentation holds that tests need to be statistically proven using careful control of independent factors, and accurate measurement of dependent variable outcomes along with their interrelationship correlation. Of course in some research using grounded theory approaches (such as some of my earlier published research), along with citations from literature (often subjectively reflected to experiences and/or case studies) can be helpful in organizing and documenting participant observations, that in turn can later be empirically tested (Weick 1985; Whitley 2002). Nevertheless, this thesis will use rigorous theory building and validation processes. Social science researchers concur that the motive and means driving the scientific inquiry paradigm is that understanding and reconstruction of individual contextual realities that people hold must be aimed towards a consensus of meaning, yet researchers must still be open to new interpretations as information and analysis methods improve (Guba and Lincoln 1994; Zechmeister, Zechmeister and Shaughnessy 2001).
3.3.1. **Experimental Course Design and Subject Population**

Based upon the preliminary findings referenced above, there was enough basic research and support to justify a more formal experiment to explore an applied research design. The next step was to conduct applied research in a commercial university setting. A proposal to conduct several 10, 14 and 22 week MBA and MScs program courses was accepted by several universities, to be carried out by the author and colleagues for research purposes. These were graduate level courses designed for a total work-load requirement of 160 hours (online asynchronous text, online synchronous lecture and presentations, asynchronous readings, homework assignments and research). The contact hours between instructor and student, beyond the instructional facilitation of the asynchronous and synchronous online environments, averages about an hour per student per course (via private online chat and asynchronous emails). No face-to-face contact is designed for these courses, albeit prior course symposia may have brought instructor and some students together. The sampling unit was the duration of each course - in this case it was 22 weeks for all encompassed by this experiment, at a specific university.

3.3.1.1. **Course Design Methodology**

The courses were all designed by myself, submitted to a quality assurance team, then revised if and where necessary, and implemented. Often a few minor changes were made just before and during their delivery. As will be explained later, I delivered three of the four courses, and my colleague delivered the forth, with myself as a silent observer. My colleague is a more experienced teacher (compared to myself). Each of the role players in our course design team apply different methodologies within their respective scope. In the course design mode, I start with a template and apply the methodology that is a modified version of the nine *Conditions of Learning Theory* (Gagné, Briggs and Wager 1992). I applied the Figure 2.6: Professional Learning Instruction Process Design Systemic Model theory during this course design exercise. The design template is an HTML framework of items (headings, examples, and checklists) necessary to consider during the design process for our online or face-to-face courses.
We have modified the context design methodology recently to better suite the online mode, which is the key model I applied during the course design (see Figure 2.7: Professional Learning Context Design Systemic Model). The enhancements for online course design also include a quality assurance role which us a governance (a type of project management oversight at the university level) that itself is a modified version of the traditional Systems Approach Model for Designing Instruction (Dick and Carey 1996). The course design programming team use the Model-Centered Instruction (Gibbons and Fairweather 1998) as their checklist for the Internet implementation of the course. For example, this quality assurance process involves a course approver ensuring the designs aligns with the Internet ‘model’ we use for delivery, then the programming team applies a Model-Centered Analysis Process to ensure the course conforms to our online delivery standards.

3.3.1.2. Course Delivery Methodology

Two of the three courses delivered by myself were based on three models from Chapter 2. Firstly, the main principles of the professional learning goal approach were applied as explained Figure 2.4: Systemic Model of Self-Regulation, Self-Efficacy, Goal-Setting. This included such techniques as self-schema building projects and activities, self-efficacy generating synchronous sessions and asynchronous assignments, self-regulation checkpoint opportunities, reminders, and intrinsically interesting content. Secondly, I again used the Figure 2.6: Professional Learning Instruction Process Design Systemic Model theory for the instruction (as I also did in the course design mode).

Thirdly, the andragogical principles were applied using a flexible schedule and assignments, with choices for individual or team work, to maintain motivation and adjust for busy schedules. Cognitive development and conceptual learning was promoted using exercises facilitating social and mastery learning, which often involved presentations and/or essay writing, in either individual or group modes. Regardless of the mode (individual or group), peer reflection and self-reflection were required, which (usually) increased meta-learning and self-efficacy (Figure 2.5: Integration of Behaviorist, Constructivist, and Social Learning Designs).
Thirdly, the final part of the course delivery was informed by customized approach I explained in “Figure 2.8: Synthesized Professional Learning Principles Model”. In reflection, all of these above models were used as guides for the actual online delivery process (thus basing adaptations in the delivery context on theory-grounded principles).

3.3.1.3. **Difference in Course Delivery Experimental Methods**

My colleague used her own instructional delivery approach, which is informed by the traditional *Conditions of Learning theory* (Gagné, Briggs and Wager 1992) as I had explained and described in steps# 1, 4, 5, 6 and 8 of “Figure 2.6: Professional Learning Instruction Process Design Systemic Model”. This is considered (and labeled) as the ‘Status Quo’ approach teaching method. I also used this ‘Status Quo’ approach in the delivery of one course. Essentially the difference focused on in this quasi-experiment was the online instructional method, which was the synthesized professional learning model as described in “Figure 2.8: Synthesized Professional Learning Principles Model” (applied to two courses, by myself) versus the ‘Status Quo’ teaching approach (applied to two other courses, one by myself, and the other by a colleague).

3.3.1.4. **Subject Descriptions and Control**

The targeted courses were related to the soft-skills of project management (e.g. organizational strategic planning, organizational human resource management, organizational behavior, and organizational project management). It was assumed that by applying improved learning design and delivery methods to the MBA and MScs level courses (of which the subject matter overlaps some topics in the project management body of knowledge), the outcomes could be generalized from the mature graduate level student populations to the professional PM community. Additional common demographic factors supporting this generalization to PMs were a random mixture of gender, age range between 22 and 45, experience range from 2-18 years, and employed work status (all students reported to be working full time, studying part-time).

It is customary in social science experiments to include possible nuisance factors into a design experiment to account for possible unexpected affect, such as gender and age, but it is also recommend to avoid including unnecessary attributes, to promote
parsimony (Zechmeister, Zechmeister and Shaughnessy 2001; Keppel and Wickens 2004) – and this approach is followed in these procedures except that there was no reason to include employment status since as mentioned above, all subjects were reported to be at an identical level for this attribute.

The students were naturally selected and thus are considered an ‘in-tact’ group. From the empiricist and positivist standpoints, it is acknowledged that a pure randomized selection and large sample is preferred, but neither of these was practical. Also since this took place in a commercial university environment with mature tuition-paying students, the ability to control all factors was of course limited, which meant this work must be labeled a quasi-experiment (Zechmeister, Zechmeister and Shaughnessy 2001, pp. 35-38). The research sharing value of assessing emergent learning theories applied to multiple business-oriented (project management-related) commercial university programs outweighs the mutable context of a quasi-experiment, as long as all implications are documented. In later subsections I will discuss alternative measures taken to address factor variability to ensure the experiment validity.

The above methods applied rigorous control to the quasi-experiment in that almost everything was held constant except the instruction itself, and where that differed, I applied both methods to serve as additional validity. Having another instructor teach one of the courses I designed (with some students I also taught) was further control. As will be explained below, the repeated measures design control the difference between course and students by having the participants function as their own control (they participated in the before and after effects).

3.3.2. Experimental Frame

The frame for this research will be sample distributions from comparable (assumed normal distributions) of higher education student populations in the selected university offering MBA and MScs related programs that include project management subject matter. As will be explained later (below and in the Chapter 4), the characteristics of this sample distribution are deemed heuristically and empirically to be normal. A significant reason this is considered comparable to a normal distribution, is there have been no reasons in past studies to believe otherwise. The psychographics (age, needs,
culture, etc.), in particular the independent factors, were similar between the sample distribution and volunteers whom participated in the preliminary pilots (Strang 2004a). Also as mentioned above, it was a natural statistical selection (almost random).

The population is considered the cumulative student body at the university for the MBA and MScs programs, which is approximately 250 current students plus all previous students. None of the students whom participated in the earlier pilots were contained in this experimental sample. Although several courses in the MBA and MScs programs are being taught by the author using this learning approach, only those ones with content of interest to professional project managers were selected for analysis in this thesis.

The parameters of interest were student performance (measured through course assessments), and satisfaction (evaluated through survey questions focused on overall student satisfaction as well as effectiveness of instructor methods). The competing theories in this case to be used as explanatory factor levels were the status quo of lassie-faire teaching methods as compared with the constructivist learning goal theoretical model developed by the author. Table 3.1 illustrates the experimental multiple-treatment repeated-measures design matrix. Additional explanation follows this table.

Table 3.1: Repeated Measures Experimental Design Matrix

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Response Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Explanatory Confounding Variables (shown on far left); Factor Levels (1 or 2)</td>
<td>Student Satisfaction After Course (0=not applicable, 1=low, 5=high)</td>
</tr>
<tr>
<td>Age, Experience, Gender, Work status, Culture</td>
<td>1. Status quo: instructor not applying learning goal theory</td>
</tr>
<tr>
<td></td>
<td>2. Instructor applying learning goal theory</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The reason that two parameters - student satisfaction and performance - were selected as dependent variables in the quasi experiment are as follows. The first reason is to use the principle of triangulation to ensure the validity (multiple measures of the same concept should correlate), and consistency (measuring same students and teaching method across multiple courses, and the same teaching method for multiple students, should generally show a positive relationship between satisfaction/performance and learning goal teaching methods). The second reason is to demonstrate discriminate validity by verifying the “Status Quo” approach used by myself and my colleague result in no change of satisfaction/performance across students and courses (instructor preference).

3.3.3. Data Collection Processes and Instruments

The primary empirical evidence sources for this thesis (focused on learning methodology) were student performance and instructor evaluations. All the source information was gathered by the university and given to me as an extract from their Learning Management System. In addition, qualitative data in the form of student comments, were posted to the online discussion forums (configured for each course), and student feedback was occasionally sent to the author by email. The qualitative data is not examined in this thesis, with exception to verifying the normalcy of the distribution, and to examine anomalies (to be discussed in a later chapter).

Construct (internal and discriminate) validity for instructor and course assessment was achieved by applying the existing (proven) evaluation format and process in place at the university across all courses but since the university forms covered minimal instructor methods-related items, the survey was enhanced to include some ‘Domains of Performance Indicators’ framework (Reeders and Marshall 1996), and Robson’s Web-based course evaluation themes (Robson 2002). The survey used typical Likert-type interval scales (0=not applicable, 1=lowest, 5=highest). The resulting survey instrument is attached in Appendix 2.

Since archival records (historical) data gathering method was employed to assess previous courses (those in which other instructors taught the same course without applying learning goal theory) the earlier version of the student survey had been
applied, and there was only one common question that could be applied to assess student satisfaction, for the total (multiple course) sample frame: item #19 as follows:

| #19. Overall, I was satisfied with this course. | 0 Not Applicable  
|                                               | 1 Strongly Disagree 
|                                               | 2 Disagree 
|                                               | 3 Neutral 
|                                               | 4 Agree 
|                                               | 5 Strongly Agree |

An additional item was available for current courses that directly measured the student’s satisfaction with the instructor’s andragogical and pedagogical methods: item #21 – this can be used in certain statistical assessments that do not examine the historical data.

| #21. The instructor demonstrated sufficient course coordination and leadership (organizing content and meetings, explaining processes, motivating students, interacting with students, applying effective learning methodology). | 0 Not Applicable  
|                                                                 | 1 Strongly Disagree 
|                                                                 | 2 Disagree 
|                                                                 | 3 Neutral 
|                                                                 | 4 Agree 
|                                                                 | 5 Strongly Agree |

The grade performance scores are weighted ratio scales of assignment and exam marks (0% to 100% with two decimal points of precision), averaged across all course work (e.g. some assignments were 10% of course weighting, additionally the exam was usually scaled at 20%). The marks were extrapolated to a final grade point value ratio (a real number reported with decimals, from 0.0 to 4.0, stored with three points of precision).

3.3.4. Statistical Methodology and Measures

The alternative learning goal theory I have developed will be tested against quantitative and qualitative data using the quasi-experimental research design described above. Using a quasi-experiment not only facilitates objectively proving factorial case-effect, it also reduces ethnocentrism (when one applies their cultural perception to another population similar to stereotyping), a bias I became aware of during my project management procurement, ethics, leadership, and culture studies.
Correlation between independent and dependent variables will be both macro and micro. At the course level of analysis, the correlation coefficient will illustrate the effect of instructional methods on the same student across multiple courses, as well as between instructors (whereby the author applied learning goal theory while other instructors did not – the other instructors discussed this with the author and were interested in learning more about these new andragogical and pedagogical methods). On a micro level of analysis, the application of learning goal theory effect will be measured on a student basis per course whereby only certain courses taught by the author used learning goal.

This quasi-experimental design will therefore require several statistical tests, involving independent and paired groups, as well as multiple regression analysis to build the best practice model. Since there are multiple possible explanatory variables (the nuisance factors such as age and experience, along with the key independent teaching method factor), combinations of these may be used in the model building analysis – there is no practical method to block the nuisance factors and since their effect could prove to be systemic, then they should be included in multiple regression analysis (Keppel and Wickens 2004, pp. 5-8). Also, since there are two dependent variables: Satisfaction and Grade Point Value (GPV). These will be assessed separately using univariate procedures (multivariate techniques are beyond the planned scope of this research experience). The dependent variables were the qualitative survey responses that are coded into frequency counts, and the interval scale survey items that used the Likert scales of 0 to 5. As mentioned above, this cross-course macro analysis which involved archival data gathering was the reason that only survey item# 19 was used in the statistical analysis as a dependent variable (additional survey items were not recorded for earlier courses).

3.3.4.1. Overall Descriptive Statistical Measures and Devices

Several customary methods and measures should be generated to provide benchmark indicators of the data. These measures will not only furnish confidence metrics to other researchers but they will also ensure the data itself does in fact represent an accurate and
normal sample distribution. Since the data will be gathered from students as they complete several courses, the number of events in the total sample size should be equal to or larger than 30 (out of a population frame of over 250), which is the recommended minimum for applying many statistical tests (Aliaga and Gunderson 2003; Keppel and Wickens 2004). The number of student enrollments used in this study is 48, over four courses. The statistical sample size for the professional learning goal analysis is actually the number of condition observations (not the number of students per group), since a paired-treatment quasi-experimental structure is applied. ‘In contrast [to independent groups designs], individuals in a repeated measures design (or within-subjects design) participate in the study more than once – specifically, they participate in each condition of the experiment” (Zechmeister, Zechmeister and Shaughnessy 2001, 156). Paired-testing is very powerful (Carlson and Thorne 1997; Keppel and Wickens 2004) and ideal when “only a small number of participants is available” (Zechmeister, Zechmeister and Shaughnessy 2001, 157).

The standard measures for the dependent variables to be reported will include the sample size, sample mean, standard deviation (variability of dependent variables from mean), and the ‘descriptive statistics’/‘five number summary’ (quartiles, median, and range). Along with the above measures, several important diagrams will be used to help in visually sharing the data trends for the reader, as well as to assist in my inspecting the characteristics and accuracy of ‘dependent variable’ data:

- frequency percentage distributions, polygons, and scatter diagrams - clustering of numerical data using two variables;
- dot plots – clustering of single numerical variable data, with key measures superimposed (mean, median, quartiles, and standardized deviations);
- box-and-whisker charts – five number summary (with one or more variable groups);
- residual plots – special form of scatter diagram used for multiple regression analysis.
The principles of reporting and graphing excellence will also be respected to ensure accurate and clear representation of the data. This ideal includes presenting data in a way that provides substance, statistics measures; communicating complex ideas with clarity, precision and efficiency; giving the largest number of ideas in the most efficient manner; as well as using formatting standards such as: including zero level on Y-axis, proper labeling, and proper-document scaling on all axes (adapted from: Tufte 2002; Aliaga and Gunderson 2003, p. 245). Also, as will be discussed later, proper ethics are applied in that the data will be verified to ensure it is accurate and complete (using both visual inspection of software database with source data, and the use of cross-referencing formulas in the spreadsheet to ensure no samples are missing and to ensure no data is transposed), and finally that any outliers are especially scrutinized for sample relevance.

I will be creating complex frequency polygons with multiple line series superimposed on histogram bars or trend lines to illustrate specific distribution contrasts. This reason I create these is that two variables with different scales can be plotted on two independent “Y” axes, such as age versus GPV across an X-axis delimited by sample number, time, or some other common interval. Of course it is acknowledged that color coding and legends allow for multiple data series to be combined within polygon charts, but only multiple Y-axis allow for this unique visual analysis of heterogeneous variables. In all cases though, the graphs are electronically linked to the database data (or frequency tables of grouped data) to ensure accuracy and factual representation of all information. The principle I employ with all narrative and diagrams is there should be sufficient information to trace a representation or transformation back to its original source.

I will be applying correlation and regression statistical techniques to analyze the relationships between the independent factors and the dependent variables, as well as with and between them. Generally speaking, correlation refers to any interdependence or association. Specifically, and commonly, it refers to a linear association. In a situation involving two variables, a correlation is measured by using a formula relating pairs of observations of the variables. The degree of linear correlation is then interpreted as the measure of how closely the cluster of graphed pairs adheres to a straight line.
Statisticians have defined other types of correlation in addition to this simple correlation between pairs of variables. Partial correlation refers to relationships that exist between pairs of variables when the other variables are held constant. A multiple correlation is a correlation between one variable and a set of other variables. The interpretation of a correlation is often difficult, because the correlation may reflect any of several different relationships (as well as an unknown variable lurking in the context). For example, the observed correlation between how many project managers smoke and their chances of contracting lung cancer is often attributed to a cause-and-effect relationship. The correlation between scores on a project manager certification exams and later continuing education performance in college, however, does not mean that high test scores indicate high college grades. Rather, both variables could be affected by the ability, age, experience and cumulative knowledge of the project manager.

Regression analysis is a statistical technique for investigating the relationship between a dependent variable and one or more explanatory, or independent, variables. Used to predict the behavior of the dependent variable from given values of the independent variables, it proceeds by (1) stating the form of a model linking the variables, (2) fitting this model to the data, (3) assessing whether the model fits well enough to be useful, and, if it does, (4) using the fitted model for prediction and other purposes. When a linear relationship is assumed, the technique is called linear regression analysis. The technique for investigating a multiple correlation (e.g. multiple explanatory independent factors) is called multiple regression analysis. Multiple regression is employed in this research.

In my discussions below, it is assumed the reader understands the statistical mnemonics used in the formulas described in this thesis (statistical test symbol definitions are excluded). The common symbols I use with all formulas are shown in Table 3.2.

*Table 3.2: Common Symbols used in Statistical Expressions*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M or μ =</td>
<td>Population or sample mean</td>
</tr>
<tr>
<td>SD or σ =</td>
<td>Sample standard deviation</td>
</tr>
<tr>
<td></td>
<td>Sample range</td>
</tr>
<tr>
<td></td>
<td>Alpha risk or regression slope</td>
</tr>
<tr>
<td>Ω² or ω² =</td>
<td>Omega, eta squared, effect size</td>
</tr>
<tr>
<td>V or δ =</td>
<td>Sample variance</td>
</tr>
<tr>
<td>N or n =</td>
<td>Sample or group size</td>
</tr>
<tr>
<td>X or χ² =</td>
<td>Chi Squared statistic</td>
</tr>
</tbody>
</table>
For each test measure, the probability value approach will be used in decision making, and the risks (limitations) will also be reported, where applicable, which are specifically:

- type I error ($\alpha$): level of significance, probability of rejecting a true null hypothesis;
- type II error ($\beta$): probability of accepting a false null hypothesis;
- confidence level (1-$\alpha$): probability that test statistic is valid when null hypothesis is true - the confidence level (cl) applied to the statistical analysis here will be 95% unless otherwise stated, which is a standard approach in the academic domain;
- test power (1-$\beta$): probability of correctly rejecting the null hypothesis when it is false;
- test statistic probability value ($p$): probability that a statistic value taken from a normal distribution would be $\geq$ the actual statistic tested if the null hypothesis were true, which means that this is calculated only after the test is performed (unlike the above metrics), and it is desirable to have a small value (less than the level of significance) if one were trying to prove an alternate hypothesis.

As mentioned above, for all statistical measures, the 95% confidence level is used and the preferred margin of error for each test statistic is 3-5%. Parametric algorithms will be preferred over distribution free alternatives because they typically are mathematically more rigorous since they apply the standard deviation for each observation in their basic calculation (therefore better representing the mean and variance of treatment samples comparing the independent and dependent variables, albeit being more sensitive to outliers). For example, nonparametric measures such as the Wilcoxon Rank Sum Signed test (and others like it) essentially measure the location of the sample median against an expected distribution of medians, while ignoring the actual value of each observation-
this does not provide much strength to statistical inference especially for large samples. On the other hand, the technique I have recently adopted is to use both parametric and distribution free algorithms for testing the same hypothesis against the same data to provide a conservative verification in case my assumptions of normality were flawed.

3.3.4.2. Measuring Hypothesized Learning Goal Method Improvement

Since the goal is to prove that applying learning goal theory in teaching busy mobile project managers will improve their performance and satisfaction from the learning process, two types of student t tests can be conducted, the first to compare courses where the author applied new theory as compared with other courses (by other instructors) where it has not been applied, and the second test to compare students taught by the author in courses with and without learning goal theory applied. The student t tests assume the populations and samples are normally distributed (otherwise a large sample over 30 should be drawn or the alternative nonparametric algorithms should be used).

The first test will employ an F test student and a t test both using the independent groups design, normally distributed, with known equal variances, using the following formulas (Carlson and Thorne 1997, p. 602; Keppel and Wickens 2004, pp. 34-35; MiniTab 2004):

\[
F = \frac{S_1^2}{S_2^2}
\]

\[
t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}
\]

Where \(df\) are the degrees of freedom, \(\bar{X}\) are sample means, \(S\) is pooled variance, \(n\) is sample size, \(\mu\) mean population difference set to 0.

**Figure 3.6: Independent Group Test Formula**

The F-test (named after statistician Ronald A. Fisher) is a one-factorial analysis of variance which compares two independent population samples to determine if their variance ratio is different (compared to the F distribution). This is typically used before
the student t test to determine if the pooled sample standard deviation formula should be used (the one at the bottom right of the previous diagram) – if the variances are equal then the sample standard deviation can be used instead (simplifies the calculations). By way of trivia, the Student t test is based on the t distribution developed by L. Gossett (student was a pen-name he used to publish his theory while working at an Irish pub).

The first test to examine the statistical significance of both teaching approaches (status Quo versus Learning Goal) on the dependent variables Satisfaction and GPV will utilize a paired student t test using dependent groups (same students taught by author across courses) with known equal variances, using these formulas (Carlson and Thorne 1997, p. 381 & 401-402; Tamhane and Dunlop 2000, p. 284; MiniTab 2004):

\[ t = \frac{\bar{D} - \mu_D}{S_D/\sqrt{n}} \]

\[ \bar{D} = \frac{\sum_{i=1}^{n} D_i}{n} \]

\[ S_D = \sqrt{\frac{\sum_{i=1}^{n} (D_i - \bar{D})^2}{n-1}} \]

Where \(\bar{D}\) is sample mean differences, \(S\) is sample variance, \(n\) is the sample size, and the population mean \(\mu\) is set to zero.

**Figure 3.7: Dependent Paired-Group Test Formula**

This is a very powerful statistical testing strategy (Tamhane and Dunlop 2000; Keppel and Wickens 2004). The purpose is to leverage the matching capability between teaching method with performance and satisfaction dependent variables from the same students I taught over multiple classes, whereby I applied learning goal theory only to selected courses (repeated measures before and after). The approach is very credible because it reduces variation between subjects by using the same students and context in the before and after. ‘It’s impossible for one group to be smarter, healthier, or more motivated than the other because the same people participate in all conditions of the experiment’ (Zechmeister, Zechmeister and Shaughnessy 2001, 157).

As I mentioned above, to be very conservative in this research, I also chose to apply a nonparametric test whenever prudent. In this case, with the independent groups design, I will use the Wilcoxon Rank-Sum Paired Test to compare two population medians (not
the means) because the medians are less affected by outliers (extreme values) – not that I experienced much of this (as the data will show) but instead my real purpose was to apply a distribution free procedure to reduce risk if the university MBA and MScs population was not normally distributed. The other advantage of this test is that it can be especially effective for small and/or unequal samples (less than or equal to 10). The formula is (Carlson and Thorne 1997, p. 576; Tamhane and Dunlop 2000, p. 330):

\[
E(T) = \mu_T = \frac{n(n+1)}{4}, \quad \text{Var}(T) = \sigma_T^2 = \frac{n(n+1)(2n+1)}{24}
\]

Where ‘E(T)” is approximated as “\(\mu\), \(\text{Var}(T)\) is “\(\sigma\)” which is the sample standard deviation, \(n\) is size, then use \(t\)-test

Figure 3.8: Nonparametric Dependent Paired-Group Test Formula

The Mann-Whitney U Statistic (used by MiniTab™) is equivalent to the Wilcoxon Rank-Sum test (Carlson and Thorne 1997, p. 575) which I apply in Excel™. I describe both of these formulas because some results are aesthetically better formatted by one or the other program in certain aspects, as such I tend to use both. These non-parametric tests are statistically less powerful than the student \(t\)-test, but are they useful especially if the assumptions for the \(t\) distribution are not fully supported, and/or the sample treatment/factor sizes are significantly different in size. Mathematically speaking, the Mann-Whitney \(U\) test is used to show differences in central location of the median, to determine if two population sample distributions are identical, using this formula (Carlson and Thorne 1997, p. 441; Aliaga and Gunderson 2003, p. 918; MiniTab 2004):

\[
U = n_1n_2 + \frac{n_1(n_1+1)}{2} - R_1, \quad E(U) = \mu_U = \frac{n_1n_2}{2}
\]

Where ‘E(U)” is approximated as “\(\mu\), \(\text{Var}(U)\) is “\(\sigma\)” which is the sample standard deviation, \(n\) is size, then use \(t\)-test

Figure 3.9: Alternative Nonparametric Dependent Paired-Group Test Formula

3.3.4.3. Confirming Learning Goal Method Variable Relationships

The hypothesis propositions that the improved learning goal teaching approach for project manager education will result in better performance scores (assumed to mean
more effective learning), as well as higher satisfaction with the learning process. Again as mentioned earlier, in addition to reporting the standard descriptive statistical indicators discussed above, this can be evaluated by first calculating the relative strength of the relationship between the key independent variable ‘teaching method’ with the first dependent variable ‘GPV’, then with the second variable ‘Satisfaction’. The coefficient of correlation (a better measure than the covariance) can be used for this, by applying these formulas (Carlson and Thorne 1997, p. 698; Aliaga and Gunderson 2003, pp. 778-780; MiniTab 2004):

\[
 r = \frac{S_{xy}}{S_x S_y} = \frac{\sum_{i=1}^{n} (x_i - \overline{X})(y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{n} (x_i - \overline{x})^2} \sqrt{\sum_{i=1}^{n} (y_i - \overline{y})^2}} = \frac{\sum_{i=1}^{n} x_i y_i}{n} 
\]

Where \(x\) are independent variable sample means, \(y\) are dependent variable sample means, \(S\) is the variance, while \(n\) is size.

**Figure 3.10: Pearson’s Correlation Test Formula**

The purpose of correlation analysis is as stated above to measure the strength of association (linear relationship) between the independent variable (teaching method) and the dependent numerical variables (GPV and Satisfaction). It does not measure the direction of the cause-effect relationship, and of course can only measure linear (not curvilinear, quadratic, or other types of patterns – this is explained later). The result is a correlation, which if closer to “1” it indicates a stronger positive linear relationship between the variables, whole conversely the closer it is to “-1” the stronger the negative linear relationship between the variables. A zero correlation means the data does not indicate any observable cause-effect relationship between the variables compared.

The coefficient of determination \(r^2\) is a slight modification to the previous formula for the correlation coefficient (calculated by squaring \(r\)), which is standard practice for showing the relative strength of the relationship (considered a stronger measurement of cause-effect than the correlation coefficient). Again this measure can indicate the strength of cause-effect but not the direction (can’t isolate the cause variable from the effect). Based on experience, a coefficient of determination \(r^2\) at 0.50 or greater indicates
a strong relationship (0.80 or above very high), while less then 0.40 shows some obvious association, and less than 0.20 might indicate moderate cause-effect factor relationship.

*Cohen’s effect size* (Cohen 1988) is another useful measure of cause-effect strength of association in multiple group/treatment experiments, which is an estimate of population variance as a result of an independent factor effect on the independent variable(s). This measurement shows the effect that the independent factor accounts for in the dependent variable and is most meaningful when there are a few (e.g. two) condition factors or treatment levels (Cohen 1992). This calculation can be applied to single and two-way ANOVA *Fisher* distribution as well as to sample *student t* distributions – the formulas are shown below. Similar to coefficient of determination $r^2$ discussed earlier, the literature reports that there are standard interpretations of *Cohen’s effect size* (Cohen 1992, pp. 157-158), whereby 0.80 (or greater) is a large effect, 0.50 corresponds to a medium effect, and finally 0.25 (note Cohen specifies 0.20) is considered a small effect size accounted for by the independent factors (Keppel and Wickens 2004, p. 162 & 174-176).

A variation of this I have noted in research is that *Cohen’s effect size* formula is executed without squaring the last result (often using the notation of omega symbol $\Omega$ or labeled as “*eta*”), with the results are interpreted using the guidelines for Pearsons Correlation $r$, whereby 0.10, 0.30, and 0.50 correspond to small, medium, and large size effects (Zechmeister, Zechmeister and Shaughnessy 2001, pp. A-10 & A-11). From my own experience, I find this latter variation is more common in regression and model building analysis. The formulas applied are (Cohen 1992, pp. 378-380; Carlson and Thorne 1997, pp.627-628):
\[
\frac{x_1 - x_2}{\delta}
\]
Where \(x_2\) is the second sample mean or the population mean can be used (if known), and the \(\delta\) is the sample or (population if known) standard deviation.

\[
SSB = K L \sum_{j=1}^{n} (\bar{x}_{j*} - \bar{x})^2
\]
The “SSB” (sum of squares between) and “SST” (sum of squares total) formulas are derived from the ANOVA single of two factor formulas (discussed later).

\[
SST = \sum_{i} \sum_{j} \sum_{l} (x_{i,j,l} - \bar{x})^2
\]

Figure 3.11: Correlation Effect Size Test Formula

### 3.3.4.4. Regression and Model-Building Methodology

This methodological discussion will gradually lead into regression analysis and systemic model building, so at this point there is a trick to the aforementioned paired design student t test and the correlation analysis algorithm above. Since the paired data comes from an assumed joint normally distributed population, then it should have a \(t\)-
distribution with \(n-2\) degrees of freedom; therefore the following formula can apply (Carlson and Thorne 1997, pp. 381, 402; MiniTab 2004):

\[
t = \frac{r - \rho}{\sqrt{(1 - r^2) / n - 2}}
\]
Where “df” are the n-2 degrees of freedom, “t” is the sample correlation coefficient, and “\(\rho\)” is the population correlation coefficient and is set to 0, n=size.

Figure 3.12: Paired-Group Variable Regression Formula

The interpretation of the above formula is that when a sample coefficient is calculated from a random sample of \(n\) pairs of observations from a joint normal distribution, if the \(t\) test statistic is greater than the critical \(t\) test distribution standard value, then the null hypothesis would be rejected and it can be assumed that a significant linear relationship between the paired group variables. The direction of correlation is indicated by the positive or negative value of the sample correlation coefficient (ranges from \(-1\) to \(1\)).

Since this quasi-experiment assumes a randomized design and normal distribution, the Analysis of Variance (ANOVA) methodology can be applied in a number of different ways to measure differences between the two teaching methods across groups (courses...
and instructors), as well as within the groups (classes). The focus of the ANOVA is to
determine if the between-group variation (different courses) is attributable to the
different treatments (different teaching methods). The Levene one-factor ANOVA test
can be used to compare differences in group medians, which can identify if the
dependent variables (GPV or Satisfaction dependent variables) differ by course, in
terms of their variance from the medians. A difference would suggest a teaching method
is different in that it affects the group outcomes differently. The formulas are shown and explained below (Carlson and Thorne 1997, p. 381; Keppel and Wickens 2004, pp. 34-38, 72, 156; MiniTab 2004):

\[
SSA = n_c \left( \bar{X}_c - \bar{X} \right)^2 + \sum_{i=1}^{n_c} \left( X_{1i} - \bar{X}_c \right)^2 + \sum_{i=1}^{n_c} \left( X_{2i} - \bar{X}_c \right)^2 + \sum_{i=1}^{n_c} \left( X_{ni} - \bar{X}_c \right)^2
\]

\[
SSW = \left( X_{11} - \bar{X}_1 \right)^2 + \left( X_{12} - \bar{X}_1 \right)^2 + \left( X_{21} - \bar{X}_2 \right)^2 + \left( X_{22} - \bar{X}_2 \right)^2 + \left( X_{n1} - \bar{X}_c \right)^2 + \left( X_{n2} - \bar{X}_c \right)^2
\]

\[
SST = \left( X_{11} - \bar{X} \right)^2 + \left( X_{12} - \bar{X} \right)^2 + \left( X_{21} - \bar{X} \right)^2 + \left( X_{22} - \bar{X} \right)^2 + \left( X_{n1} - \bar{X} \right)^2 + \left( X_{n2} - \bar{X} \right)^2
\]

\[
MSA = \frac{SSA}{c-1} \quad MSW = \frac{SSW}{n-c} \quad F = \frac{MSA}{MSW}
\]

The variables are complicated (the software used in this research calculates them), using the “c” columns, “n” size, degrees of freedom (F distribution stat).

*Figure 3.13: Single Factor Analysis of Variance Formula*

The result of a Levene ANOVA test will indicate if the means are different between the
treatment groups which in turn indicates the independent variable is having an effect.
The Table 3.3 below illustrates the customary format in which the ANOVA results are
reported, and the example includes the meaning of the above intermediate calculations
outcomes are: the “MSA” which indicates the variability between (among) the factor
groups (for this experiment this would highlight the variance of learning goal teaching
method as compared to status quo between the courses), and the “MSW” which reports
the variance within the groups (independent variables, such as in this research, the
variability from one student to another). Finally the most important outcome in the
ANOVA test is the “F Test Statistic” which should be greater than “1” to indicate a
variance between factors (null hypothesis false) – this value is compared to the critical F
value pre-calculated in the *F distribution* (with specified the degrees of freedom).
Table 3.3: Example ANOVA Result Reporting Format

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Squares (Variance)</th>
<th>F Statistic (Ratios)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among (Between) Factors</td>
<td>C-1</td>
<td>SSA</td>
<td>$MSA = \frac{SSA}{C - 1}$</td>
<td>$\frac{MSA}{MSW}$</td>
</tr>
<tr>
<td>Within Factor Error</td>
<td>N – C</td>
<td>SSW</td>
<td>$MSW = \frac{SSW}{(N - C)}$</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>N – 1</td>
<td>SST</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The one-factor ANOVA evaluates the difference among the mean responses of two or more sample populations (e.g. classes), using the $F$ test as a robust calculation to moderate any possibility of departure from normality (as compared with the $t$ test). The approach to apply ANOVA to this research will be to consider each course having an implicit method (e.g. the instructors differed, me versus others), and the actual methods differed as well (I used learning goal theory for one course and status quo for another).

The ‘among/between group” variation is weighted by the sample size in each group (each class). The ‘within group” (error) will be used to measure the variability in the GPV and Satisfaction dependent variables. If the calculated $F$ test statistic is greater than the critical $F$ value, and if the calculated probability value is less than the level of significance, then the null hypothesis of no difference is rejected (the desirable outcome), showing support for the alternate hypothesis theory that applying learning goal methods will affect (hopefully increase) dependent variables. The table below illustrates how the data needs to be organized to support this one-factor ANOVA test concept (the course Group starting with ‘L” are pseudo names coded from the actual quasi-experiments).
Table 3.4: ANOVA Test Configuration Setup

<table>
<thead>
<tr>
<th>Course Group:</th>
<th>GPV Means</th>
<th>Satisfaction Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSOB6206 (status quo – different instructor)</td>
<td>GPV scores</td>
<td>Survey item#19</td>
</tr>
<tr>
<td>LEOB6206 (status quo – author as instructor)</td>
<td>GPV scores</td>
<td>Survey item#19</td>
</tr>
<tr>
<td>LKOB6206 (learning goal – author instructor)</td>
<td>GPV scores</td>
<td>Survey item#19</td>
</tr>
<tr>
<td>LKMS6103 (learning goal – author instructor)</td>
<td>GPV scores</td>
<td>Survey item#19</td>
</tr>
</tbody>
</table>

However, the one-way (single factor) ANOVA algorithm does not illustrate which group or method was different (if the median variances were different). Since more than two group comparisons might be needed (e.g. there were four courses in the experiment), multiple comparisons can be simplified by using the Tukey-Kramer formula to identify the sample means that are different in pair-wise tests (if the result of ANOVA above formula showed that the variances were different). This Tukey-Kramer formula is (Carlson and Thorne 1997, p. 606-607; Keppel and Wickens 2004, pp. 120-121):

\[
\text{Critical Range} = Q_{U(c,n-c)} \sqrt{\frac{MSW}{2}} \left( \frac{1}{n_j} + \frac{1}{n_j} \right)\]

Using ‘MSW’ from above, where \( n = \) sample size.

Figure 3.14: Tukey-Kramer Variable Significance Test Formula

This absolute mean difference calculation is done for each treatment group pair, and compared with a critical student \( Q \) value, and if the former calculation is larger than the latter critical value, then the means are different for the two treatment groups (Tukey 1977). This process is different than the previously described independent and dependent paired student \( t \) tests, since the latter \( t \) tests compare only two means, not a group of them. Actually there is also another \( Q \) distribution for this test statistic.

If the normal distribution assumptions are questionable, the nonparametric equivalent to the one-factor ANOVA can be applied, which is the Kruskal-Wallis Rank Test to locate different sample medians (an extension of the Wilcoxon rank-sum test), shown below
(Carlson and Thorne 1997, p. 381; Aliaga and Gunderson 2003, pp. 917-920; Keppel and Wickens 2004, pp. 34-38, 72, 156; MiniTab 2004):

\[
W = \frac{12}{n(n+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(n+1)
\]

Where \( R_i \) are the rank sums, \( n = \) sample size, and the Chi Square \( \chi^2 \) distribution is used.

**Figure 3.15: Kruskal-Wallis Rank Nonparametric Variable Significance Test Formula**

Unfortunately this test may not really apply here in that although it is distribution free (uses the Chi Square distribution) an assumption is that the dependent variable is continuous (e.g. a measurement) but the GPV and Satisfaction are discrete numbers. I will have to investigate this further because the GPV would be a quasi-ratio variable.

### 3.3.4.5. Explaining Variable Interactions for Systemic Model Building

The recommended research testing methodology involves first defining the population domain, selecting corresponding parameters along with statistical testing formulas; secondly, transforming the competing theories into hypotheses (null and alternative) while also stating the level of significance and decision rules; thirdly, collecting or examining the data then verifying any assumptions (using descriptive measures and graphs); fourthly, computing the test statistic(s) with probability value(s); and fifthly, making a decision substantiated by the reasoning, accompanied by its implications (Yin 1994; Zechmeister, Zechmeister and Shaughnessy 2001; Aliaga and Gunderson 2003; Keppel and Wickens 2004).

Once one has defined theory, then applied a research design to explain it, the next step is typically to interpret the results to determine if the theory holds-up in a real (or experimental) context. The best scientific method to prove a theory works in practice is to design an experiment (or quasi-experiment as I have done here), then perform various statistical tests, analysis of variance, and multiple regression between independent and dependent factors, to confirm theory or possibly revise a model. The term model is defined here as a representation of how a theoretical system of principles works in practice, using independent factors/levels, showing their effect on dependent variables.
This process starts with the two-factor ANOVA with interaction which expands on the one-factor ANOVA model, by showing the interaction for 2 or more independent variables in terms of who they effect a dependent variable, as well as showing the possibility that the independent variables may interact with one another. So, the testing involves seeing if there is a group level effect, a dependent variable block effect and an independent variable interaction effect.

The formulas for calculating each intermediate result are shown below (Carlson and Thorne 1997, p. 612; Keppel and Wickens 2004, pp. 34-38, 72, 156):

\[
\begin{align*}
SST &= \sum_i \sum_j \sum_l (x_{il} - \bar{x})^2 \\
SSG &= H \sum_{i=1}^{K} (\bar{x}_{i*} - \bar{x})^2 \\
SSB &= KL \sum_{j=1}^{H} (\bar{x}_{*j} - \bar{x})^2 \\
SSI &= L \sum_{i=1}^{K} \sum_{j=1}^{H} (\bar{x}_{ij*} - \bar{x}_{i*} - \bar{x}_{*j} + \bar{x})^2 \\
SSE &= \sum_i \sum_j \sum_l (x_{il} - \bar{x}_{ij*})^2
\end{align*}
\]

The variables are complicated (the software used in this research calculates them), using the “c” columns, “h” size, degrees of freedom (F distribution stat).

Figure 3.16: Two-Factor Analysis of Variance Formula

If the F test ratio is greater than the critical F value for each variation level of analysis (e.g. each row in the two-factor ANOVA outcome table), the null hypothesis is rejected, with the conclusion that the means (factors) are not equivalent (there is a teaching method/explanatory variable test effect on the GPV and Satisfaction scores which differs between the groups), otherwise the conclusion is that the groups and methods (from averaging the GPV and Satisfaction) are equivalent (the latter meaning the teaching methods are similar in terms of the outcomes they produce on GPV and Satisfaction). The table below shows the standard format for reporting the two-factor ANOVA result (Carlson and Thorne 1997, p. 614; Keppel and Wickens 2004, pp. 34-38, 72, 156; MiniTab 2004):
Table 3.5: Example Two-factor ANOVA Result Reporting Format

<table>
<thead>
<tr>
<th>Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares (Variance)</th>
<th>F Statistic (Ratios)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>SSG</td>
<td>$K - 1$</td>
<td>$MSG = \frac{SSG}{K - 1}$</td>
<td>$MSG$</td>
</tr>
<tr>
<td>Between blocks</td>
<td>SSB</td>
<td>$H - 1$</td>
<td>$MSB = \frac{SSB}{H - 1}$</td>
<td>$MSB$</td>
</tr>
<tr>
<td>Interaction</td>
<td>SSI</td>
<td>$(K - 1)(H - 1)$</td>
<td>$MSI = \frac{SSI}{(K - 1)(H - 1)}$</td>
<td>$MSI$</td>
</tr>
<tr>
<td>Error</td>
<td>SSE</td>
<td>$KH(L - 1)$</td>
<td>$MSE = \frac{SSE}{KH(L - 1)}$</td>
<td>$MSE$</td>
</tr>
<tr>
<td>Total</td>
<td>SST</td>
<td>$KHL - 1$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table below illustrates how the data should be organized to accommodate the application of the two-factor ANOVA to this research for the purpose of testing interaction between GPV and Satisfaction dependent variables (which there should likely be), as well as testing the difference between the independent factors of teaching method per course, and also their effect on each student. Once again the course group titles are pseudo names for the actual course codes.

Table 3.6: Two-Factor ANOVA Configuration Setup

<table>
<thead>
<tr>
<th>Course Group:</th>
<th>Student 1</th>
<th>Student 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSOB6206 (status quo – different instructor)</td>
<td>GPV Mean, Satisfaction</td>
<td>GPV Mean, Satisfaction</td>
</tr>
<tr>
<td>LEOB6206 (status quo – author as instructor)</td>
<td>GPV Mean, Satisfaction</td>
<td>GPV Mean, Satisfaction</td>
</tr>
<tr>
<td>LKOB6206 (learning goal – author instructor)</td>
<td>GPV Mean, Satisfaction</td>
<td>GPV Mean, Satisfaction</td>
</tr>
<tr>
<td>LKMS6103 (learning goal – author instructor)</td>
<td>GPV Mean, Satisfaction</td>
<td>GPV Mean, Satisfaction</td>
</tr>
</tbody>
</table>

The two-factor ANOVA procedure leads into the multiple regression methodology to apply least squares formulas to determine possible linear equations which could explain the variable interactions, and thus build a systemic model using an algebraic formula.
The formulas underlying the linear regression are shown below (Carlson and Thorne 1997, p. 727-628; Keppel and Wickens 2004, pp. 217-218; MiniTab 2004):

\[
\sigma^2_{b_i} = \frac{\sigma^2}{\sum_{i=1}^{n} (x_i - \bar{X})^2} = \frac{\sigma^2}{(n-1)S^2_X}
\]

\[
S^2_{b_i} = \frac{S^2_e}{\sum_{i=1}^{n} (x_i - \bar{X})^2} = \frac{S^2_e}{(n-1)S^2_X} \sum_{i=1}^{n} e_i^2
\]

Where “\(\sigma\)” is the population standard deviation, “\(S\)” is sample variance / standard deviation, \(n\) is size, and the ANOVA \(F\) test is used; \(\hat{y}\) is least squares equation.

Figure 3.17: Two-Factor ANOVA Regression Formula

The purpose of computing the regression is to use the data available to compute “estimates” or numerical values for the coefficients, \(b_0\), and \(b_1\) which can be developed into a formula to allow the prediction of a dependent variable by knowing the independent one. These estimates are calculated by using Least Squares Regression, a technique widely implemented in statistical packages such as the ones used here (MiniTab™ and MS Excel™). The least squares is a procedure that selects the best fit line given a set of data points, by minimizing the sum of the squared deviations of the points in a line (the points in this case would actually be the dependent variable values).

Of course with any of the regression type algorithms, the coefficient residuals should be examined to confirm there are no lurking independent variables (by looking for curvilinear, quadratic, or other patterns). The one-factor ANOVA formula is actually applied to the regression coefficients and residuals to determine if the variation (in the residuals) is significant. Additionally the coefficient of partial determination \((r^2)\) is calculated (as explained earlier) to determine the degree of variation of \(Y\) is explained by each \(X\) variable. The adjusted \(r^2\) is also calculated to reduce the \(r^2\) in order to reflect the number of variables in the model as well as to reflect the sample size.

To follow up the regression and ANOVA test for regression, the Durbin-Watson statistic can be computed to indicate any possible autocorrelation (on the x-axis) in the...
residuals of the dependent Y variables (this is an undesired effect that may show as a curvilinear or other pattern as described earlier). The benchmark for autocorrelation is a residual error variance of zero, which translates to a preferred statistic of close to 2 (Tamhane and Dunlop 2000, pp. 147-148). The Durbin-Watson statistic can be calculated to measure serial collinearity of the independent variables using the following formula (Carlson and Thorne 1997, pp. 805-806; Tamhane and Dunlop 2000, pp. 147-148; MiniTab 2004):

\[
\begin{align*}
    d &= \frac{\sum_{t=2}^{n} (e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} \\
    \text{Where} &\quad \text{``e'' is squared residuals; if } d <> 2 \text{ then autocorrelation may be present (undesired effect).}
\end{align*}
\]

Figure 3.18: Durbin-Watson Autocorrelation Formula

A basic assumption in (statistically significant) multiple regression is homoscedasticity which means the error residuals in a linear equation model have a constant variance over the x-axis of independent factors (Carlson and Thorne 1997, pp. 797-808). Otherwise heteroscedasticity (the opposite condition) could exist because the independent variables may have a nonlinear relationship (e.g. exponential, logarithmic, quadratic, serial as described above, and others), which based on my experience (and the literature) this means that the residuals of independent heteroscedastic factors will likely form a recognizable linear pattern. The following figure is a conceptual abstract of this phenomenon (adapted idea from: Carlson and Thorne 1997).
Residual Analysis for Independence

- Heteroscedasticity
- Homoscedasticity
- Quadratic Pattern
- No Particular Pattern

Residuals plotted against x-axis independent factors

Figure 3.19: Regression Residual Multicollinearity Example

If a logarithmic linear model is appropriate the recommended approach is to make the transformations (e.g. apply a base 10 LOG function to the independent variables) to estimate a log linear model. Another possible cause if the error terms in a regression model are correlated with one another is for time series data to affect the behavior of many of these factors over several time periods (the result would be a correlation between the error terms that are close together in time) – this can often be resolved by applying quadratic scaling (e.g. square or square root) to transform the independent variables.

The Variance Inflationary Factor (VIF) can be calculated to measure the collinearity (combined linear association) of the independent X factors, on the dependent variable, using the following formula (Tamhane and Dunlop 2000, pp. 415-417):

\[
\text{VIF} = \frac{1}{1 - r^2_j}
\]

Where ‘r’ is coefficient of multiple determination; if VIF = 1 then the explanatory variables are not correlated (good effect), VIF <= 5 indicates moderate correlation, while VIF > 10 indicates high multicollinearity with the independent factors (an undesired effect).

Figure 3.20: Variance Inflationary Factor (VIF) Combined Collinearity Formula

The VIF actually measures the correlation of the independent factors (e.g. teaching method, age, experience) with each other to determine, whereby higher VIF results indicate more collinearity. As suggested above, it is standard practice to consider independent factors with VIF > 10 as intercorrelated, whereby the recommended action is to remove them from the regression model (Tamhane and Dunlop 2000, pp. 415-417).
Some writers recommend removing independent factors from a regression model if the VIF is > 5 (Snee 1973), but my mathematical experience has shown that 10 is usually a more appropriate VIF threshold for the removal of a factor in a linear model with unequal sample sizes and a mix of interval/ratio variables such as the case here.

### 3.3.4.6. Summary: Regression and Model Building Steps

The recommended steps for identifying a best-practice model from multiple regression research are (adapted from: Tamhane and Dunlop 2000; Keppel and Wickens 2004):

1) create a research model using most likely independent variables (this may require building new transformed ‘dummy’ variables factored against existing ones);
   a) develop a scatter plot of X on Y to observe possible relationship;
   b) perform residual analysis to check the assumptions (thus us unexplained variability);
   c) use a histogram, stem-and-leaf display, box-and-whisker plot, or normal probability plot of the residuals to uncover possible non-normality;

2) create regression correlation and ANOVA which includes all above independent, transformed and dependent variables to generate variance inflationary factors;
   a) if there is violation of any assumption, use alternative methods (e.g.: least absolute deviation regression or least median of squares regression) to least-squares regression or alternative least-squares models (e.g.: curvilinear or multiple regression);
   b) if there is no evidence of assumption violation, then test for the significance of the regression coefficients (using the ANOVA F test) and construct confidence intervals and prediction intervals.

3) remove independent variables with VIF>10, if any removed regenerate the model;

4) perform all/best-subsets regression to identify the best independent(s) variable model;

5) select model from above with a result close to/less then number_of_variables + 1;
6) reanalyze above including residual plots, add any required quadratic/linear terms 
(and if so repeat back to second step above), then select/apply the overall best 
model.

As discussed earlier, the approach to research testing applied in this thesis will be the 
traditional hypothesis formulation (but using the more accurate computer-generate 
probability values rather than the density curve critical values), generation of test 
statistic value(s) using generally accepted procedures, then the evaluation of result(s) 
using probability value(s), followed by its interpretation.

The above methodology and procedures stated several axiomatic assumptions about the 
sample population being used in this experiment, mainly referring to being a normal 
distribution, which is bell-shaped (the numerical variables are counted and plotted in 
frequency diagram, with more values in the center of the histogram), and there are many 
‘families’ of sample distributions similar to the larger overall population distribution.

The statistical formulas often make use of the normal (and other) distributions by 
converting the normal probabilities of mean averages between these numerous samples 
distributions as compared with the base population distribution (based on montecarlo 
simulations) into cumulative relative frequency histograms, which are actually density 
curves, such as the case with the Z test value – this is a standardized metric indication 
typically how far a sample mean will vary from the normal population mean.

Thus in statistics, for normal distributions, three standardized benchmark scores are 
often applied to estimate the likelihood that a sample mean will vary a specified 
distance (of standard deviations) from the normal population mean: $1\sigma$ (68%), $2\sigma$ 
(97%), and $3\sigma$ (99%). From a rationalistic viewpoint (and as a limitation), this means 
that if a number of samples are taken from a normal population, there is 68% probability 
that the sample mean will be within one standard deviation of the normal population 
mean. This concept also applies the central limit theorem that affirms if a "large"
sample is taken from any population, then the sampling distribution of the mean (and the sampling distribution of the sum or total) is also approximately normal.

There are additional ‘proven’ and commonly used cumulative probability density distributions available in statistics which are used in the statistical tests I discussed for comparing to the standardized test values, such as the *Student t* (not skewed), *Fisher F* (right skewed), and *Chi Square* $\chi^2$ (right skewed). The normal distribution (*Z test*) is symmetrical (not skewed), but where a sample size is small or violates normal distribution assumptions, the Chi Square, ‘T’ and ‘F’ distributions can be used. Figure 3.21 (adapted concepts and diagrams from: Aliaga and Gunderson 2003) illustrates how these density distribution histogram models compare (there are additional less-used statistical distributions, such as Poisson, Uniform, Bernoulli, Q, but they are not included here since I believe they are not as essential to visualize for sample distribution normalcy). The value of including these examples here is that the percentage distribution polygons can be visually compared with Figure 3.21 for normalcy.

![Normal_Z, Student_T, Fisher, ChiSquare](image)

**Figure 3.21: Commonly-Used Statistical Density Distribution Models**

Two common statistical algorithms are used to measure the normalcy of a sample in terms of proximity to a normal distribution. These are skewness and kurtosis, as shown in below. Skewness characterizes the degree of asymmetry of a distribution around its mean. Positive skewness indicates a distribution with an asymmetric tail extending toward more positive values. Negative skewness indicates a distribution with an asymmetric tail extending toward more negative values. Kurtosis characterizes the relative ‘peakness’ or flatness of a distribution compared with the normal distribution. A positive kurtosis indicates a relatively peaked distribution while a negative kurtosis indicates a relatively flat distribution.
Applying Learning Theory to Improve PM

Chapter 3: Methodology

Figure 3.22: Skewness and Kurtosis Distribution Assessment Formulas
“Skewness” and “Kurtosis” formulas are applied to ensure the sample data distribution
is normal, which is essential for using parametric tests (Keppel and Wickens 2004, pp.
144-145). A perfect skewness indicates excellent symmetry which would require the
test value to be close zero (Tamhane and Dunlop 2000, p. 27). Kurtosis measures
sample dispersion (probability of sample means being away from mean), and all
variables should meet the ±3σ rule of thumb (Tamhane and Dunlop 2000, p. 118) to be
considered a normal distribution sample. In general with a sample such as this quasiexperiment (n=48, 4 courses), kurtosis should be positive and less than or equal to 2
(based on my statistical experience); another opinion is more liberal. “The normal
distribution is regarded as a light tail distribution (because it has very little probability in
its tails, e.g. beyond three standard deviations from the mean) and has β2=3”, albeit it
should be noted “skewness and especially kurtosis are not very reliable estimates unless
the sample size is sufficiently large, say at least 50”(Tamhane and Dunlop 2000, p.
118).
3.3.5. Statistical Risk Mitigation
Although students were not briefed on my research, my theories and research papers
were promoted through links on the university’s websites and/or in their library
systems. Therefore the process was transparent enough that it could have been read by
some students causing them to behave differently than pure uninformed randomized
selection would have, and thus this may have confounded some of the conditions in my
experiments (my opinion was that there was no significant bias effect). This was
mitigated using factors controllable either through manipulation or paired testing to
eliminate or reduce the effects of confounding variables. Also since the same students
(and same context) were used in the paired testing, they essentially become their own
control to simulate a completely factorial randomized experimental design. The type of
Page 137


teaching method applied was not documented nor communicated to students, to control for Hawthorne (superordinate attention), social facilitation, and mere-exposure effects.

Simpson's paradox is a possible aggregation bias when data fields are summarized which may lead to misleading results due to unknown/uncontrolled lurking variables (Tamhane and Dunlop 2000, pp. 131-132; Aliaga and Gunderson 2003, p. 777). Additional bias can exist from expectancy, which arises through practice effects of differential transfer. Practice effect is a known side affect in repeated measures designs because the same student could be measured in two courses, one after the other, where the learning goal theory was applied (maybe to one and/or the other). Also the possibility of carry over of good and/or bad experiences between student and instructor from one course to another especially those in consecutive order as part of our MBA and MScs programs (known as differential transfer) could have occurred. These bias were acknowledged to be risks for students taking multiple courses with the instructor (author) since this would allow for familiarity with the application of learning goal theory. Nonetheless, both of these potential weaknesses (practice effect and differential transfer) were addressed here by having at least a few students take courses roughly in parallel (this was coincidentally a natural selection process too). The pair-wise testing will provide a high degree of control for practice effects and lurking variables. “An important advantage of repeated measures designs is that they are generally more sensitive than an independent groups design” meaning “they can detect the effect of an independent variable on the dependent variable even if the effect is a small one” (Zechmeister, Zechmeister and Shaughnessy 2001, p. 157).

Randomization and treatment pairing approaches were used to offset aggregation bias in the following manner. Firstly, a normal distribution and randomization can be assumed here because students were taking courses as part of larger programs of study at these universities while the learning goal theory was applied to certain courses in a single blind manner (students were not aware of the details of my theoretical research except what was required under disclosure to uphold proper ethics). Secondly, the same students (in some cases) were tracked from course to course whereby one course was
using learning goal theory, while the other was not (in this sense the student was their own control group in paired before/after treatment experimentation). Additionally the instructor (this author) was constant in that particular situation, thus permitting a pairing of dependent samples for variable interaction testing (considered a stronger statistical technique as compared with testing means, medians, or standard deviations between independent sample populations). Thirdly, possible lurking variables (confounding factors) associated with the instructor and/or methods were isolated as some paired tests included students with a different instructor (other than the author) across different courses (there was no planned before/after treatment difference in that control group). Finally, the bias of prior experience with learning goal theory (and familiarity with instructor methods) was minimized through natural selection since only three students of all sample populations had previously taken a course from the author during this experiment.

3.3.5.1. Subject Population, Attribute Risk and Mitigation

There were many other possible differences between the students in this natural in-tact group design, which is relevant only because not every individual in the control group (previous course) also chose to enroll in one of the classes I taught using learning goal theory. Rather than exhaustively list all possibilities of variables that may cause selection bias due to individual student differences, the table below summarizes likely attributes common to these experiments (adapted from: Zechmeister, Zechmeister and Shaughnessy 2001, p. 155).

Table 3.7: Common Selection Bias Factors

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Personality</th>
<th>Cognitive State</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td>Agreeableness</td>
<td>Depression</td>
<td>Race</td>
</tr>
<tr>
<td>Religion</td>
<td>Extroversion</td>
<td>Anxiety level</td>
<td>Gender</td>
</tr>
<tr>
<td><strong>Economic status</strong></td>
<td>Emotional stability</td>
<td>Drug use</td>
<td>Age</td>
</tr>
<tr>
<td>Marital status</td>
<td>Self-directed</td>
<td>Brain damage</td>
<td>Intelligence</td>
</tr>
<tr>
<td>Dependents</td>
<td>Confidence</td>
<td>Previous stress</td>
<td>Can sit and think</td>
</tr>
<tr>
<td>Location</td>
<td>Studious</td>
<td>Current stress</td>
<td>Work long hours</td>
</tr>
<tr>
<td>Internet quality</td>
<td><strong>Culture</strong></td>
<td><strong>Related experience</strong></td>
<td></td>
</tr>
</tbody>
</table>

Also different learning styles in particular students would be less or more affected by learning goal theory. Note that I have included some of these potential balancing factors
in my design (specifically age, gender, and experience), but I have specifically omitted what I consider an important one, culture, which I will explore in future studies. Preliminary analysis was applied using a two-factor ANOVA to prove that culture as an explanatory variable did not affect the other dependent variables. Although roughly 15% of my students were from countries outside of the university (it was internationally accredited), the entrance assessment ensured that they were roughly equivalent in basic knowledge to the other 85% of domestic (Canadian) students, including their ability to study in the English language (used for all courses). Also, as pointed out by research associates, Canada has a multicultural population, which makes this 85% homogenous to the 15% international students, in this experiment sample frame.

Although I originally conjectured that culture would be a confounding variable in global project management studies, culture had minimal effect here in this experiment, mainly because as my investigations found, all of the 15% international students had studied outside their home country, many in fact had lived and studied in Canada or United States. The portion of international students in the experimental research frame originated from the following countries (in order of descending frequency): United States, India, Denmark, United Kingdom, Iran, Egypt, and Singapore. As mentioned earlier, work status (also identified as economic status here) was consistent across 100% of the students so this attribute was not included in the research design for further analysis.

3.3.6. Mitigation of Threats to Experiment Validity

Albeit it is more common to apply instrument validity controls to survey type procedures (and I do include one survey in my experiment), I also apply it here as an oversight for the statistical procedures (where applicable). In the discussions below I apply the wisdom of more experienced writers, and to appropriately match the nature of my thesis with an appropriate research paradigm and experimental design, with literature sources from management science (Kemmis and McTaggart 1988; Eisenhardt 1989; Sekaran 1992; Yin 1994; McNiff and Whitehead 2000) and others from social psychology (Schön 1983; Cohen 1988; Daniel 1990; Babbie 1993; Zechmeister, Zechmeister and Shaughnessy 2001). As noted previously, rigorous statistical controls
have been applied to the data analysis based on literature (Snee 1973; Marascuilo and McSweeney 1977; Dixon and Massey 1983; Hinkle, Wiersma and Jurs 1988; Cohen 1992; Babbie 1993; Carlson and Thorne 1997; Tamhane and Dunlop 2000; Aliaga and Gunderson 2003; Keppel and Wickens 2004).

In terms of the validity of the research design, there was no likely history (recency) effect on the students since the courses were on the regular schedule (no special idiosyncratics\(^{12}\)). As discussed earlier, the selection was not random but instead natural and in-tact (students enrolled of their own accord without any knowledge of the experiment and without any influence from the teacher or university administration). There was some pre-testing of the students to gain entrance to the MBA and MScs programs, but this was to ensure competence of the English language. The entrance requirement procedures included verification of appropriate prerequisite education and years of experience. Since the learning goal method was a new theoretical application, and no student was tested beyond one course semester under this method, there would be no logical opportunity for maturation or expectancy. There were no dropouts from the course once they commenced (no experimental mortality).

The face validity applies mostly to the survey in the sense that it should measure what it is intended to (satisfaction with the course and with the teaching/learning methods). The comments fields offer an additional measure to confirm the satisfaction.

Construct validity refers to an instrument’s measure of valid variables to enable valid analysis to be undertaken based on a theorized hypothesis. In this case the independent factors of age, experience, gender, and teaching method are assessed against the dependent variables Satisfaction and GPV score. These are common variables to correlate in educational psychology experiments and this they should be acceptable here.

\(^{12}\) Idiosyncratics refer to a structural or behavioral characteristic peculiar to an individual or group, such as physiological or temperamental peculiarity Houghton-Mifflin (1994). The american heritage® concise dictionary. USA, 1994 INSO Corporation.
Content validity ensures the measures adequately measure the concept. Since I have carefully researched the statistical formulas and I have experience using both MiniTab™ and Excel™ software programs, I am certain these are appropriate. The course survey used by the university has been in use for several years (and I have no control over its items or the data collection). Both the statistical formulas and the survey instruments are useful, accurate and valid. Criterion validity is related to the content validity above but it asks the question: does the measure differentiate in a manner that helps to predict a criterion variable, such as do Satisfaction and GPV scores really reflect the effectiveness of the new learning goal teaching methods or its lack there of? In this case I believe the criteria applied are valid. Furthermore, although the author would have assessed the performance of the students within certain groups on the experiment (which would impact the GPV score), the Satisfaction variable is not controlled by the author.

Concurrent validity is also related to the above in that statistical tests should assess a variable such that individuals/groups known to be different on the test are shown to be so in the significance of the result. For example, in the paired tests, the same students serve as their own control (multiple treatments), since in one class they receive status quo methods, while in another class learning goal theory is applied – in this case the tests should illustrate a difference in the result (which is of course assuming the theory works).

Predictive validity is desired here to predict future performance of a variable based on defined criteria – such as being able to predict higher satisfaction and/or better performance based on the criteria of learning goal theory (versus status quo methods). Convergent validity is achieved when the independent factors correlate, such as the GPV score measuring increases age, experience, and learning goal methods should relate. Discriminate validity is the opposite of the above in that the independent factors should not be correlated to the dependent variables in any situation of the experiment. These two conditions were actually scientifically assessed using appropriate statistical tests (as discussed earlier), to measure interaction of factors, instability (experiment test significance), and sample distribution normality.
3.3.7. Equipment

The technology products used were operational systems at the university with proprietary software environments modeled closely to the commercial WebCT™ product. Some testing involved using a version of the BlackBoard™ software and SiliconChalk™, all of which are similar commercial systems providing electronic virtual classroom environments (web-based). I should mention that the preliminary thesis research pilots (Strang 2004a) involved the Pearson CourseCompass™ facility which is a modified licensed version of BlackBoard™, and TestGen™ (which was also applied in this experiment).

Another technology product used was Elluminate Live™ to provide virtual synchronous meetings, whiteboard and audio conferencing through low-speed dialup (for the purpose of establishing access from global locations with known low-speed capability). The minimum client equipment requirement was a standard pentium pc, with a Netscape or Explorer browser, dial-up or high-speed Internet access, and an inexpensive ($25) microphone-headset. The purpose of using those products was to facilitate both course design and delivery, as well as offer ubiquitous remote access through the Internet using industry standard browsers such as Netscape™, Explorer™, and X-Motive type environments (e.g. Unix, Mac – espoused to be compatible but not tested here). As mentioned earlier, MS Excel™ as well MS Access™ and Oracle™ databases were used. MiniTab™ for Windows was used for the detailed statistical calculations and MS Excel™ was used for the production of the graphics and tables to accompany the statistical analysis tests, especially the multiple regression model building. These products (MiniTab and Excel) were most useful when used together to leverage the strengths of each, respectively, yet rely on the other to provide a numerical/statistical cross-reference to ensure formula and data entry accuracy. Microsoft Project™ was used to technically manage and monitor the overall research project effort.

3.3.8. Research Ethics

The application of ethics was rigorous in that several standards applied: the university code of ethics for research, the Project Management Professional™ code of ethics,
Fellow Life Management Institute™ code of conduct, and the policies of the various universities where the emergent teaching methods were used. The thesis itself falls under the policies and procedures outlined in a university document entitled *Policy and Procedures for the Degree of Professional Doctorate* (March 2003, Research and Graduate Studies Academic Board). The university human research ethics sub-committee application for approval of projects involving human subjects (research ethics form) was submitted, approved by the university, and was strictly adhered to throughout the research. The ethical consent letter is attached in Appendix 1.

Disclosure was given to subjects involved in this research, which included providing letters of the research purpose to university management of the groups studied. These disclosures were also provided to subjects involved in the preliminary thesis research pilots. The purpose of the final commercial experiments was kept confidential from the subject students (only the university administration provided informed consent), to better control the independent variables. Additionally, the recent *Privacy Act* (Canada, R.S. 1985, c. P-21; available: [http://laws.justice.gc.ca/en/P-21/text.html](http://laws.justice.gc.ca/en/P-21/text.html); updated to August 31, 2004) places a high level of responsibility on companies and employers in the author’s home country to maintain employee and client confidentiality. Therefore the institutions involved in this research requested that all information (processes, identities, techniques, materials) be kept confidential – consequently, section 18.1 of the *Policy and Procedures for the Degree of Professional Doctorate* (2004) were applied.

There was absolutely no psychological risk to the subjects of these quasi-experiments since the teaching role was to use appropriate pedagogical methods to facilitate the learning of the course objectives, while following the university’s policies and procedures – all stakeholders, students, teacher, and university administration, held the same desire to see courses completed successfully with good performance marks. The other essential ethical requirement was for the author to ensure the data was properly gathered, accurately entered into the statistical software, and the results correctly interpreted. Privacy is respected in that since the universities have requested that their identity, as well as the identity of their students, remain confidential, this will be upheld here. The universities were also debriefed on the research findings to ensure that both
the data as well as analysis were accurate and reasonable in the context. University management approved of this research.

Finally, as implied above, the universities that I have been collaborating with fully endorse and encourage this research as they realized this was an opportunity to lead emergent teaching experiments and that could improve their competitive advantage.

3.4. Synthesizing Findings for the Research Community

The final stage in discussing the research methodology is to describe the approach to organize and communicate the eventual findings to the academic community. In this respect the purpose is to describe the analytical device (not the process) for doing so. A multi-year endeavor such as this thesis contains much work, which is further complicated by the scientific method and rationalistic-versus-positivist paradigms employed. Again, borrowing from the constructivist educational principles of Chapter 2, and to achieve a balance between the rationalistic and logical positivist philosophies discussed at the beginning of this chapter, a proven survey assessment instrument is utilized here, rather than reinvent the wheel.

The idea of concept mapping has proven useful to synthesize and communicate complicate concepts - hopefully this was the case at the end of Chapter 1. An extension to the concept map is the Vee Heuristic Diagram (Novak and Gowin 1984), that was developed using the techniques of Socratic questioning (sequentially asking questions to draw out knowledge), and meta-learning, to form a high-level question and answer knowledge structure that summarizes a project. The difference between Vee Diagrams and concept maps is the former are incrementally documented at several stages through the project, while concept maps are completed usually at either the project start or end.

Recent extensions to the Vee Heuristic have customized it for communicating research findings to the academic community (Åhlberg 1993). The current version is described as ‘an action research framework for planning, implementing and evaluating a course of
action with the aim of improving a situation …[containing] ten theoretically justified
steps to high quality learning and thinking” (Åhlberg and Ahoranta 1999, p. 12).

This device has proven useful in this thesis to prepare work for publication, since it aligns with the requirements of reviewers in terms of questions a good research article must answer to. The value of using it lies in the ten topical imperatives, which are recognized and accepted by the research community, whereas the graphics are aesthetic.

Specifically, the recent version contains ten labels as knowledge scaffolding to construct hypothesis generation or testing relationships about a domain of research, to illustrate the hierarchical, conceptual/propositional nature of the project, from start-to-end. The framework commences with the focus, covers planning, implementation, and concludes with evaluation. An adapted version of a research project-oriented Vee Diagram is shown in Figure 3.23 (adapted from: Åhlberg and Ahoranta 1999).

![Figure 3.23: Vee Heuristic of a Research Project (Åhlberg and Ahoranta 1999)](image)

Researchers will recognize the merit of such a device since it poses questions required by the academic community, to establish credibility and conceptual understanding.
based on what was done at the start, middle, and end of a project. For example, the last output for a *Vee Diagram* is a value claim addressed to the research community (or journal’s editorial board). As such, this tool works well in combination with the project governance discussed earlier. As mentioned above, the *Vee Diagram* (unlike pure concept or knowledge maps) cannot be completed until the research is evaluated.

3.5. Chapter Summary
The research infrastructure and paradigm explained in this chapter were designed to be both parsimonious (clear and simple) as well as pragmatic. The formulas and software tools selected are customary yet effective. The methodology and practices articulated here are deemed necessary for the research and they leverage the educational psychology ‘professional learning goal principles’ explained in Chapter 2. The statistical-testing algorithms, graphing techniques and risk mitigation procedures will be rigorously applied in the next chapter to analyze the sample data and explain the results.
4. RESULTS AND INTERPRETATIONS

An empiricist philosophical style is applied here to convey the outcomes – the ‘exactly what’ from the statistical tests (the ‘tests’ and controls were described in Chapter 3).

4.1. Introduction

This Chapter starts by summarizing the quasi-experimental design (discussed in Chapter 3), and it restates the hypothesis to be tested. Next you will find a section explaining the general validity checking indicators and overall variance measurement, which is designed to numerically and visually illustrate the normalcy and trends in the sample data. Subsequent sections progress into very detailed factorial analysis. This begins at the group level of analysis, comparing the status quo and professional learning goal methods to each other, with all course data combined in a single frame. This course-level analysis used both parametric and nonparametric tests to determine if the teaching method is statistically significant, which the results do indicate. Since the course-level results are significant, group-wise comparisons are used to determine which courses had the most significant result variance (to identify the most successful method).

The next segment in the chapter analyzes the status quo versus professional learning goal approach at the individual level. The first test is one of the most powerful experimental design aspects of this research, using pair-wise tests to reduce confounding effects by having the same people compared in a before and after treatment of the two teaching methods. This individual level of analysis uses both parametric \( t \)-tests as well as nonparametric \( h \)-tests; the latter is used as a conservative measure to circumvent unknown violations of normalcy (as explained in Chapter 3). All of these tests will show the desired support toward the research propositions, so at this point (with a statistically significant learning goal approach) attention will be focused on factorial interaction.

The experiment factorial interaction analysis explores the strength of the relationship between the teaching method and the outcomes, and it examines the cause-effect pattern between factors and variables using standard formulas (Keppel and Wickens 2004, p.
Correlation and simple regression are applied to accomplish this, by analyzing the linear relationships between the teaching method (as an overall independent factor), to determine its effect on the dependent variables (GPV and Satisfaction). Following that, a more detailed level of analysis is conducted using multiple regression and correlation to determine the strength and direction of cause-effect relationships between (and within) several of the independent factors (teaching method as well as age, experience, and so on), linked to the two dependent variables (GPV and Satisfaction).

The last two statistically intensive subsections of this chapter progress through a systemic model building exercise (again as explained in Chapter 3), using stepwise multiple regression to determine factor and variable interactions. The latter part of the exercise involves creating new factors (I call it transforming them) using mathematical expressions (such as logarithms of age), to identify hidden combined cause-effects in the data (this is analogous to data mining in the insurance industry). Furthermore, the outcome variables are transfigured as input factors, to determine if the cause-effect is opposite to my hypothesized logic. Finally a subjective learning context indicator is added as a factor as an attempt to explain the unknown statistical cause-effect variance (this deviation is listed as standard error in many of the test results). The chapter finishes with a summary of the correlation and multiple regression model-building results.

4.2. Quasi-Experiment Overview

The quasi-experiment design, methods, subjects, and data gathering procedures were explained in Chapter 3 (see sections 3.3.1. Experimental Unit and Subject Population and 3.3.2. Experimental Frame in particular). As a brief restatement, four online (Internet-hosted) credit courses with project management-related content were delivered to professionals registered in the MBA and MScs programs. The author taught three of them (in this experimental frame\textsuperscript{13}), applying the new learning goal approach to two of the three, and a peer faculty member taught the forth course using customary methods. The enrollments were natural, with no information given about the professional learning goal approach. The instructors marked all interim work, assignments, and exams then
submitted them to the university, and the university verified the final GPV course marks, as well as gathered responses from the end-of-course-surveys. The sample data was provided to this quasi-experiment as a direct extract from the university’s Learning Management System, then imported into MiniTab™ and MS Excel™ for analysis. The students completed course surveys as well as offered periodical constructive feedback through emails; this qualitative data is reported and analyzed in the next chapter.

The hypothesis outlined in Chapter 1 (see section 1.5.1. Hypothesis) was as follows:

* $H_0 =$ the business-as-usual (status quo) teaching methods will be just as effective;

* $H_1 =$ professional learning goal approach will increase GPV score and satisfaction.

It is the “$H_1$” (alternative hypothesis) which this dissertation is attempting to test and prove by applying the professional learning goal approach.

### 4.3. Overall Descriptive Statistics and Validity Indicators

Table 4.1 lists the standard statistical measures for the independent factors and dependent variables (several key figures of interest bolded and explained later).

**Table 4.1: Descriptive Statistics**

<table>
<thead>
<tr>
<th>Statistical Measure</th>
<th>Independent Factors</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age, Experience, Gender, Teaching Method</td>
<td>Satisfaction, GPV</td>
</tr>
<tr>
<td>Mean $\mu$</td>
<td>35.02083, 13.375, 35 M/13 F, 73% M / 27% F</td>
<td>4.2083333, 3.41916</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.9327995, 0.860699</td>
<td>0.1029629, 0.03691</td>
</tr>
<tr>
<td>Mode</td>
<td>39, 17</td>
<td>4, 3.56</td>
</tr>
<tr>
<td>Standard Deviation $\sigma$</td>
<td>6.462624, 5.963096</td>
<td>0.7133479, 0.25574</td>
</tr>
<tr>
<td>Sample Variance $\delta$</td>
<td>41.765514, 35.55851</td>
<td>0.50886525, 0.06540</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.866795, -1.043806</td>
<td>-0.9452758, 0.10973</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.176821, -0.128022</td>
<td>-0.3291702, -0.76551</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Five-Number Summary</th>
<th>Inter-quartile Range</th>
<th>Minimum</th>
<th>First Quartile</th>
<th>Median</th>
<th>Third Quartile</th>
<th>Maximum</th>
<th>Plot frequency intervals</th>
<th>Sample Size n</th>
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<tr>
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<td>Inter-quartile</td>
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<td>21</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0.99</td>
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<td>First Quartile</td>
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<td>3.28</td>
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<tr>
<td></td>
<td>Median</td>
<td>36</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3.445</td>
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<tr>
<td></td>
<td>Third Quartile</td>
<td>39</td>
<td>17</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3.616</td>
<td>5</td>
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<td></td>
<td>Maximum</td>
<td>47</td>
<td>25</td>
<td>2</td>
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<td>5</td>
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<td></td>
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<td>48</td>
</tr>
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</table>

13 The author taught other courses at the university besides those in the quasi-experiment.
Most of the statistics in Table 4.1 are self-explanatory. ‘Inter-quartile’ range is added to the ‘Five Number Summary’ subsection for analysis purposes. Some numbers are truncated in Table 4.1 (and other tables in this chapter) for display purposes. A critical analysis of the findings is presented below.

‘Skewness’ and ‘Kurtosis’ (along with $\mu$ and $\sigma$) are examined to ensure the sample data distribution is normal, which is essential for using parametric tests (Keppel and Wickens 2004, pp. 144-145). Skewness indicates excellent symmetry with all variables being close to zero (Tamhane and Dunlop 2000, p. 27). The slight negative skewing of the independent factors and dependent variables in this sample suggest for example that these students are likely to have a slightly lower age or experience mean variation (like a few months), and slightly higher outcome homogeneity, as compared with the normal (whole student body) population. Kurtosis measures sample dispersion (probability of sample means being away from mean), and all variables are very low, confirming the $\pm 3\sigma$ rule for a normal distribution (Tamhane and Dunlop 2000, p. 118). ‘Gender’ and “Teaching Method” are categorical independent factors with only two discrete values; therefore the dispersion and symmetry are not relevant.

What is considered critical to this research is showing the independent factors in this sample are reasonable in terms of the global project manager population, which the reader can judge by examining “Age” ($\mu=35$, $\sigma=6.5$, range=23) and “Years Experience” ($\mu=13$, $\sigma=6$, range=21). In other words, these were not undergraduate students, but instead working professionals taking a higher education degree on a part-time basis. Although there were more males (73%) than females (27%) in the sample, this is considered representative of the project management population based on demographics of the 153,952 membership (circa 2005) in the Project Management Institute (PMI 2000; 2005). Similar online education studies argue there is little evidence that gender is a significant professional learning factor (Stonebraker and Hazeltine 2004). Nine of the students in the sample frame stated they perform project management related job duties at their work (based on interviews).
As discussed in Chapter 3, precautions were taken to avoid a *Simpson's Paradox* by analyzing the data at both the aggregate and individual course levels. *Selection* bias was avoided through natural enrollments. “Teaching Method” may be a bit misleading since it refers to an ordinal category variable representing two states of “Status Quo” (0) or “Learning Goal” (1) methods, the latter being the key model driver propositioned and tested in this research experiment. The remaining measures include the commonplace “five number summary” metrics (quartiles, etc.), which are also normal. The “Plot frequency intervals” are used to group data (bins) in the scatter plots and polygons.

The dependent variables naturally show little variation, which is more appropriately analyzed using scatter diagrams, such as the unique Figure 4.1 that shows “GPV” and “Satisfaction” plotted against “Years of Experience” (leftmost y-axis) and “Age” (x-axis), using a second y-axis (since their scale ranges are overlapping). The key finding denoted by this modified plot is a normal distribution scatter of the dependent variables across age and experience factors (gender is excluded since it is not deemed significant). For example, the “diamond” symbol for “Age” and “Experience” begins low on the y-axis (years of experience), at the leftmost x-axis (age), and rises in a consistent linear pattern as age and experience increase…which is a reasonable finding, that these both would increase together in a related fashion.

Also the normalcy of the sample is indicated by a reasonable spread in age and experience. This can be cross-referenced from Table 4.1 (examine the standard deviations, which was just discussed two paragraphs ago). The other normalcy indicator is a fairly even spread of “Satisfaction” and “GPV” across the student ages, meaning that the as you progress across the x-axis (age), the “Satisfaction” and “GPV” data on the second y-axis are very level with some normal variation, suggesting there is no obvious visual pattern in relation to either Age or Experience. In summary, Figure 4.1 portrays a normal sample distribution in terms of GPV score and Satisfaction level plotted against Years of Experience and Age.
Table 4.2 shows the five-number-summary (plus means and standard deviations) for the dependent variables by course (these are coded starting with an ‘L’, e.g. ‘LSOB6206’). The bolded figures in Table 4.2 show that the results from each course is statistically normal and similar to each other with no outliers. The means, medians, and standard deviations in particular, of the GPV scores and Satisfaction levels for each course, are very close to one another, with no extreme values. There is ‘some’ variation of these metrics between courses, which indicates a reasonable sample, and this is the key focus of the statistical analysis in this chapter – to investigate the cause-effect of these slight variations to determine if there is a pattern which can be attributed to a learning approach.

Table 4.2: Dependent Variable Summary Statistics by Course

<table>
<thead>
<tr>
<th>Statistic Measure</th>
<th>GPV by Course (n=48)</th>
<th>Satisfaction by Course (n=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Status Quo Method</td>
<td>Learning Goal Approach</td>
</tr>
<tr>
<td></td>
<td>LSOB6 206</td>
<td>LEOB6 206</td>
</tr>
<tr>
<td>Min.</td>
<td>2.8</td>
<td>3.042</td>
</tr>
<tr>
<td>Q1</td>
<td>3.24</td>
<td>3.374</td>
</tr>
<tr>
<td>Median</td>
<td>3.4</td>
<td>3.578</td>
</tr>
<tr>
<td>Q3</td>
<td>3.56</td>
<td>3.726</td>
</tr>
<tr>
<td>Max.</td>
<td>3.64</td>
<td>3.774</td>
</tr>
<tr>
<td>Size</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Mean µ</td>
<td>3.3458</td>
<td>3.510833</td>
</tr>
<tr>
<td>SD σ</td>
<td>0.2481</td>
<td>0.244267</td>
</tr>
</tbody>
</table>
As the table conveys, GPV and satisfaction means were higher for Learning Goal mode (\textit{LKOB6206} & \textit{LKMS6103}), while the variation in scores were actually lower (Status Quo GPV $\sigma_1 \sim 0.248 & \sigma_2 \sim 0.277 >$ Learning Goal GPV $\sigma_3 \sim 0.244 & \sigma_4 \sim 0.178$; and Status Quo Satisfaction $\sigma_5 \sim 0.562 & \sigma_6 \sim 0.667 >$ Learning Goal Satisfaction $\sigma_7 \sim 0.454 & \sigma_8 \sim 0.483$). This is a desirable trend to lend statistical evidence towards the research propositions since these indicators prove there are higher scores/satisfaction levels while at the same time less dispersion of averages surrounding the means and medians in the sample distribution. These inferential findings, specifically the means, medians, and standard deviations for each of the four courses, are consistent with one another and with the overall metrics of all courses combined (i.e. compare these statistics with Satisfaction $\mu_1 \sim 4.21, \text{median}_1 \sim 4, \sigma_1 \sim 0.713$; and GPV $\mu_2 \sim 3.42, \text{median}_2 \sim 3.45, \sigma_2 \sim 0.256$; from Table 4.1).

The box-and-whisker plots in Figure 4.2 provide visual confirmation of the sample data normalcy across the four (color-coded) courses, at the minor expense of redundancy from Table 4.2 metrics. As discussed in Chapter 3, using box plots to visually analyze and present key results from the sample data, is a standard practice in contemporary statistical analysis because it allows other researchers and readers to quickly see the normalcy and spread of the results. The “inter-quartile range” is represented by vertical bars at each left/right extreme, with the “median” at the center vertical line, bounded by “quartiles”. It is difficult to see that the median and 3\textsuperscript{rd} quartile for satisfaction in courses \textit{LKOB6206} and \textit{LKMS6103} are at the right range. Figure 4.1 and Figure 4.2, combined with Table 4.1 and Table 4.2 measures, corroborate the central tendency and approximate symmetry.
The histograms shown in Figure 4.3 and Figure 4.4 graph the dependent variable frequency counts on the y-axis across the x-axis intervals using the interval grouping bin ranges calculated in Table 4.1. Again, as explained in Chapter 3, using histograms to explain sample data is a common and recommended practice in contemporary statistical analysis because “you can spot obvious deviations from normality, like multiple modes, the presence of extreme scores, and skewed distributions” (Keppel and Wickens 2004, p. 144). This practice of using histograms and plots to visually assess sample data normalcy applies to Figure 4.1 (shown earlier), Figure 4.2, Figure 4.3, Figure 4.4, Figure 4.5 and Figure 4.6. As noted earlier skewness and kurtosis are acceptable.

The y-axis shows the frequency counts and the x-axis shows the grouping intervals used to accumulate the counts. A relevant point to emphasize here is that the intervals were strategically calculated by applying the principle of the Central Limit Theorem (if interested a good explanation of the theorem can be found in: Aliaga and Gunderson 2003), and the ideology of the Six Sigma movement (for an interesting application of Six Sigma see: Gack 2003). Mathematically speaking, ± three standardized deviations of a sample mean should approximate most (99.73%) of the population mean in a normal density distribution. Deductively, four standard deviations on each side of the
mean should capture all sample means, so a divisor of eight is used to calculate intervals.

![GPV by Teaching Method](image)

Figure 4.3: GPV Dependent Variable Histogram by Teaching Method

The bars refer to the Status Quo (lassiez-faire) teaching method, while the line plots the learning goal approach counts. Both of these figures illustrate that there are higher occurrences (more students reporting higher results) in the right-most intervals at the top of both the GPV and Satisfaction scales, when the learning goal approach is applied, as compared with the Status Quo method. The higher satisfaction finding reported by students taught with the Learning goal approach becomes noticeably distinct at the rightmost line and bar in Figure 4.4 (which of course is a desired experiment effect).
The next two diagrams, Figure 4.5 and Figure 4.6, are percentage frequency density polygons which provide another view of the each dependent variable’s normal sample distribution, color-coded by teaching method, across the frequency group intervals.

Since these polygons graph the line as a percentage (not count), it provides a better relative comparison of dependent variable outcomes by the method (independent factor), across the whole sample distribution. Again, as with the aforementioned histogram charts, both of these polygon graphs show higher GPV scores and satisfaction levels when the learning goal approach is applied (right portion of x-axes are higher).
A logical positivist assessment reveals an observable property of these descriptive statistics is, a lesser relative increase in GPV scores (yet still an observable trend) when
moving from the results of a Status Quo to the Learning Goal approach, as compared with Satisfaction. This is evident in y-axis percentages for both series of each polygon, as there is a higher percent when the professional learning goal approach is applied (compared with status quo) in the outcome range towards the right of the x-axis. Therefore, performance and satisfaction increase under learning goal approach.

4.4. Learning Method Comparisons at Group Level of Analysis

As mentioned earlier, the goal of these statistical tests is to prove that applying learning goal theory in teaching busy mobile project managers will improve their performance and satisfaction. The previous section presented evidence that the overall sample is normal and also there appears to be an increasing trend (higher values) of GPV and Satisfaction results in the third and forth courses where the learning goal method was applied. Several tests will be reported here to scientifically examine these dependent variable variances.

The first detailed test phase employed an overall omnibus F-test and a student t-test, using the independent group design, which is a course by course comparison. The requisites were earlier confirmed, and the sample variances are assumed to be approximately equal (the latter is important to mention since the course class sizes were unequal). The F-test and student t-test procedures are repeated for each dependent variable.

Levene’s single-factor analysis of variance F-test results summarized in Table 4.3, comparing the four independent population sample groups (courses), reveals their GPV variance ratios are different. The computed F-statistic of 3.0802368 is larger than 1 (the minimum acceptable threshold for this test), and it is also larger than the critical standard value; therefore, \( H_0 \) is rejected at the 5% level of significance \( (p=0.0370531) \). This finding supports the research proposition that the application of the learning goal approach achieves higher professional learner performance scores. Note that these ANOVA tests have been applied with a formula referencing each independent group’s exact size (Keppel and Wickens 2004, pp. 54-58) to increase accuracy.
Table 4.3: Single-Factor ANOVA between Method and GPV across Courses

<table>
<thead>
<tr>
<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSOB6206</td>
<td>17</td>
<td>56.88</td>
<td>3.3458823</td>
<td>0.0615882</td>
</tr>
<tr>
<td>LEOB6206</td>
<td>9</td>
<td>29.572</td>
<td>3.2857777</td>
<td>0.0765834</td>
</tr>
<tr>
<td>LKOB6206</td>
<td>12</td>
<td>42.13</td>
<td>3.5108333</td>
<td>0.0596665</td>
</tr>
<tr>
<td>LKMS6103</td>
<td>10</td>
<td>35.538</td>
<td>3.5538</td>
<td>0.0317781</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>0.5335280</td>
<td>3</td>
<td>0.1778426</td>
<td>3.0802368</td>
<td>0.0370531</td>
<td>2.8164635</td>
<td>0.1735647</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2.5404145</td>
<td>44</td>
<td>0.0577366</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.0739426</td>
<td>47</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Levene’s ANOVA1 F-statistic of 3.445002 and the results summarized in Table 4.4 disclose the Satisfaction variance ratios are different, so again $H_0$ is rejected at the 5% level of significance ($p=5.263E-06$), giving strong support to the alternative hypothesis. This finding also supports the research proposition that the learning goal method results in higher professional learner satisfaction levels.

The omega effect size is an effective technique when testing two variables (Zechmeister, Zechmeister and Shaughnessy 2001, p. A-10). The GPV eta’s in Table 4.3 reveal most of the variation is taking place within the independent groups ($\Omega \sim 83\%$ within, $\Omega \sim 17\%$ between). This could be considered a ‘small” variability accounted for by the method (Cohen 1988). Satisfaction eta’s in Table 4.4 show a medium effect size of method on the variable ($\Omega \sim 54\%$ within, $\Omega \sim 46\%$ between), granting cause for a learning goal approach impact.
Table 4.4: Single-Factor ANOVA between Method and Satisfaction across Courses

<table>
<thead>
<tr>
<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSOB6206</td>
<td>17</td>
<td>64</td>
<td>3.7647058</td>
<td>0.3161764</td>
</tr>
<tr>
<td>LEOB6206</td>
<td>9</td>
<td>34</td>
<td>3.7777777</td>
<td>0.4444444</td>
</tr>
<tr>
<td>LKOB6206</td>
<td>12</td>
<td>57</td>
<td>4.75</td>
<td>0.2045454</td>
</tr>
<tr>
<td>LKMS6103</td>
<td>10</td>
<td>47</td>
<td>4.7</td>
<td>0.2333333</td>
</tr>
</tbody>
</table>

Source of Variation | SS    | df | MS    | F       | P-value | F crit | Effect Size |
---------------------|-------|----|-------|---------|---------|--------|-------------|
Between Groups       | 10.952287 | 3  | 3.6507625 | 12.390377 | 5.263E-06 | 2.8164635 | 0.4579353   |
Within Groups        | 12.964379 | 44 | 0.2946449 | 0.5420646 |
Total                | 23.916666 | 47 |        |         |

The $t$-test is the most common inferential statistic for hypothesis testing involving two group experimental designs (Zechmeister, Zechmeister and Shaughnessy 2001, p. A-3). It would be useful to apply a standard $t$-test algorithm to this sample data such that other researchers could use the results as a benchmark, yet the first step is to overcome the constraint that we have four independent groups while the formula requires two. Hence, at this point one can apply an inductive empiricist technique to reduce four groups to two (since the previous tests have scientifically established a significant overall difference between the learning methods). To complete exercise the dependent variable results are combined from the two Status Quo classes together, and the same for the two learning goal approach courses, for each variable respectively. Then the student $t$-test is performed, treating these as independent groups. This posteriori statistical technique has the advantage of almost doubling the independent group sample size to increase the mathematical testing power.

The first student $t$-test was applied using a one-tailed alternate hypothesis that the GPV sample means where the learning goal approach was applied would be greater than the Status Quo method (which is more logical than just-testing for inequality between the means). This procedure can be applied using the pooled sample standard deviation formula (Keppel and Wickens 2004, p. 26) since the single-factor ANOVA test was significant. The results in Table 4.5 with a $t$-statistic of -2.99711 indicate alternate hypothesis support (learning goal approach is more effective since means by pooled variance larger), accordingly $H_0$ is rejected at the 5% level of significance ($p=0.002191$).
Table 4.5: One-Tailed Student T-Test for GPV Variation between Methods

<table>
<thead>
<tr>
<th>Measure</th>
<th>StatusQuo</th>
<th>Learning Goal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.325077</td>
<td>3.530364</td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>0.064774</td>
<td>0.045353</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>26</td>
<td>22</td>
<td>48</td>
</tr>
<tr>
<td>Pooled Variance</td>
<td>0.055907</td>
<td>-2.99711</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>0.002191</td>
<td></td>
</tr>
<tr>
<td>Df</td>
<td>46</td>
<td>1.678659</td>
<td></td>
</tr>
</tbody>
</table>

4.4.1. Nonparametric Tests of Learning Method Across Courses

In a reflection-in-action perspective, researchers such as myself often question if their assumptions of normalcy are valid with in-tact classroom-size multiple group experiments. Notwithstanding Levene’s one-factor ANOVA F-tests conducted above are robust evaluations of overall differences among the dependent variable mean responses even when sample distributions are not completely normal (Keppel and Wickens 2004, p. 145), nonparametric tests are even less sensitive to substantial skewness or distribution differences (Keppel and Wickens 2004, p. 146). As explained in Chapter 3, to this end I apply distribution-free algorithms as a conservative logical positivist philosophy, which examine the location of the sample medians (not means)
between the independent groups. Next I apply the equivalent *Mann-Whitney U* and *Wilcoxon Rank-Sum* tests using the ‘combined method groups’ and I report the latter results here. The *Wilcoxon Rank-Sum* test-statistic 4.345241 \((p=1.39\times10^{-5})\) in Table 4.7 affirms earlier *t-test* findings that Satisfaction is affected when Learning Goal theory is applied \((H_0\) rejected at 5\% level).

**Table 4.7: Wilcoxon Rank-Sum Test for Satisfaction Variance between Methods**

<table>
<thead>
<tr>
<th>Wilcoxon Rank-Sum Test</th>
<th>Satisfaction</th>
<th>(H_0): (\mu_{SQ} = \mu_{LG})</th>
<th>(H_1): (\mu_{SQ} &lt;&gt; \mu_{LG})</th>
<th>(\Delta = 5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Quo Method Population 1 Sample Size</td>
<td></td>
<td></td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Population 1 Sum of Ranks</td>
<td></td>
<td></td>
<td></td>
<td>427</td>
</tr>
<tr>
<td>Learning Goal Method Population 2 Sample Size</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Population 2 Sum of Ranks</td>
<td></td>
<td></td>
<td></td>
<td>749</td>
</tr>
<tr>
<td>Total Sample Size n</td>
<td></td>
<td></td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>T1 Test Statistic</td>
<td></td>
<td></td>
<td></td>
<td>749</td>
</tr>
<tr>
<td>T1 Mean</td>
<td></td>
<td></td>
<td></td>
<td>539</td>
</tr>
<tr>
<td>Standard Error of T1</td>
<td></td>
<td></td>
<td></td>
<td>48.32874</td>
</tr>
<tr>
<td>Z Test Statistic</td>
<td></td>
<td></td>
<td></td>
<td>4.345241</td>
</tr>
<tr>
<td>Lower Critical Value</td>
<td></td>
<td></td>
<td></td>
<td>-1.95996</td>
</tr>
<tr>
<td>Upper Critical Value</td>
<td></td>
<td></td>
<td></td>
<td>1.959961</td>
</tr>
<tr>
<td>Two-Tail Test p-value</td>
<td></td>
<td></td>
<td></td>
<td>1.39\times10^{-5}</td>
</tr>
</tbody>
</table>

Likewise, the *Wilcoxon Rank-Sum* test-statistic 2.855444 \((p=0.004298)\) shown in Table 4.8 agrees with *t-test* findings that (combined group) GPV scores are affected more when Learning Goal theory is applied \((H_0\) is again rejected at 5\% level of significance).

**Table 4.8: Wilcoxon Rank-Sum Test for GPV Variance between Methods**

<table>
<thead>
<tr>
<th>Wilcoxon Rank-Sum Test</th>
<th>GPV</th>
<th>(H_0): (\mu_{SQ} = \mu_{LG})</th>
<th>(H_1): (\mu_{SQ} &lt;&gt; \mu_{LG})</th>
<th>(\Delta = 5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Quo Method Population 1 Sample Size</td>
<td></td>
<td></td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Population 1 Sum of Ranks</td>
<td></td>
<td></td>
<td></td>
<td>499</td>
</tr>
<tr>
<td>Learning Goal Method Population 2 Sample Size</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Population 2 Sum of Ranks</td>
<td></td>
<td></td>
<td></td>
<td>677</td>
</tr>
<tr>
<td>Total Sample Size n</td>
<td></td>
<td></td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>T1 Test Statistic</td>
<td></td>
<td></td>
<td></td>
<td>677</td>
</tr>
<tr>
<td>T1 Mean</td>
<td></td>
<td></td>
<td></td>
<td>539</td>
</tr>
<tr>
<td>Standard Error of T1</td>
<td></td>
<td></td>
<td></td>
<td>48.32874</td>
</tr>
<tr>
<td>Z Test Statistic</td>
<td></td>
<td></td>
<td></td>
<td>2.855444</td>
</tr>
<tr>
<td>Lower Critical Value</td>
<td></td>
<td></td>
<td></td>
<td>-1.95996</td>
</tr>
<tr>
<td>Upper Critical Value</td>
<td></td>
<td></td>
<td></td>
<td>1.959961</td>
</tr>
<tr>
<td>Two-Tail Test p-value</td>
<td></td>
<td></td>
<td></td>
<td>0.004298</td>
</tr>
</tbody>
</table>

4.4.2. *Isolation Tests of Learning Method by Course*
Since there is sufficient statistical evidence to conclude that Satisfaction levels and average GPV scores differ by course, the Tukey-Kramer procedure can be applied to isolate which of the respective courses (groups) were significantly different. These group-to-group comparisons buttress (strengthen the findings of) the like-method class merging of the previous $t$-tests.

The Tukey-Kramer test results in Table 4.9 impart that course Satisfaction mean comparisons were significantly different for those bolded, namely for all the comparisons to groups 3 and 4 (at the 5% level of significance), which is the result desired, meaning the Satisfaction averages from courses applying learning goal approach were different. The Tukey-Kramer Q-statistic for comparing group mean differences was explained in Chapter 3 (see Figure 3.14: Tukey-Kramer Variable Significance Test Formula). This is a positive and significant finding.

Table 4.9: Tukey-Kramer Test to Isolate Satisfaction Mean Differences

<table>
<thead>
<tr>
<th>Tukey-Kramer</th>
<th>Satisfaction</th>
<th>Comparison</th>
<th>Absolute Difference</th>
<th>Std. Error of Difference</th>
<th>Critical Range</th>
<th>Result: Means = or &lt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>Sample Mean</td>
<td>Sample Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSOB6206 Group 1</td>
<td>3.764705 17</td>
<td>Group 1 to Group 2</td>
<td>0.013071</td>
<td>0.15822513</td>
<td>0.5980</td>
<td>=</td>
</tr>
<tr>
<td>LEOB6206 Group 2</td>
<td>3.777777 9</td>
<td>Group 1 to Group 3</td>
<td>0.985294</td>
<td>0.14471663</td>
<td>0.5470</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>LKOB6206 Group 3</td>
<td>4.75 12</td>
<td>Group 1 to Group 4</td>
<td>0.935294</td>
<td>0.15296496</td>
<td>0.5782</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>LKMS6103 Group 4</td>
<td>4.70 10</td>
<td>Group 2 to Group 3</td>
<td>0.972222</td>
<td>0.16925141</td>
<td>0.6397</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>Level of significance</td>
<td>0.05</td>
<td>Group 2 to Group 4</td>
<td>0.922222</td>
<td>0.17635593</td>
<td>0.6666</td>
<td>&lt;&gt;</td>
</tr>
<tr>
<td>Numerator d.f.</td>
<td>4</td>
<td>Group 3 to Group 4</td>
<td>0.05</td>
<td>0.16434452</td>
<td>0.6212</td>
<td>=</td>
</tr>
<tr>
<td>Denominator d.f.</td>
<td>44</td>
<td>MSW</td>
<td>0.2946449</td>
<td>Q-statistic</td>
<td>3.78</td>
<td></td>
</tr>
</tbody>
</table>

Unfortunately, as Table 4.10 divulges, the statistical test did not find any particular GPV average to be significantly different at the course level of analysis, albeit the comparisons between groups 1 and 2 (Status Quo) with the group 4 (Learning Goal) came close to being significant (compare bolded “Absolute…” and “Critical Range” column values).
### Table 4.10: Tukey-Kramer Test Isolating GPV Mean Differences

<table>
<thead>
<tr>
<th>Tukey-Kramer</th>
<th>GPV</th>
<th>Comparison</th>
<th>Absolute Difference</th>
<th>Std. Error of Difference</th>
<th>Critical Range</th>
<th>Result: Means = or &lt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>Sample Mean</td>
<td>Sample Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSOB6206 Group 1</td>
<td>3.345882</td>
<td>17 Group 1 to Group 2</td>
<td>0.060105</td>
<td>0.07004093</td>
<td>0.2648</td>
<td>=</td>
</tr>
<tr>
<td>LEOB6206 Group 2</td>
<td>3.285778</td>
<td>9 Group 1 to Group 3</td>
<td>0.164951</td>
<td>0.06406117</td>
<td>0.2422</td>
<td>=</td>
</tr>
<tr>
<td>LKOB6206 Group 3</td>
<td>3.510833</td>
<td>12 Group 1 to Group 4</td>
<td><strong>0.207918</strong></td>
<td>0.06771243</td>
<td><strong>0.256</strong></td>
<td>=</td>
</tr>
<tr>
<td>LKMS6103 Group 4</td>
<td>3.5538</td>
<td>10 Group 2 to Group 3</td>
<td>0.225056</td>
<td>0.07492189</td>
<td>0.2832</td>
<td>=</td>
</tr>
<tr>
<td>Level of significance</td>
<td>0.05</td>
<td></td>
<td><strong>Group 2 to Group 4</strong></td>
<td><strong>0.268022</strong></td>
<td>0.07806682</td>
<td><strong>0.2951</strong></td>
</tr>
<tr>
<td>Numerator d.f.</td>
<td>4</td>
<td>Group 3 to Group 4</td>
<td>0.042967</td>
<td>0.07274978</td>
<td>0.275</td>
<td>=</td>
</tr>
<tr>
<td>Denominator d.f.</td>
<td>44</td>
<td>MSW</td>
<td></td>
<td></td>
<td>0.057737</td>
<td>Q-statistic</td>
</tr>
</tbody>
</table>

4.5. Learning Method Comparisons at Individual Level of Analysis

This section changes the focus from the course macro level of analysis to the individual micro level evaluation. The first test will be to examine the significance of both teaching approaches (status Quo versus Learning Goal) on the dependent variables (satisfaction and GPV). This utilizes the statistically powerful *paired student t-test*. The configuration for this experiment uses dependent subgroups from the whole sample to pair the same student in a repeated-measures before/after (treatment matching) scenario.

This design was structured such that the ‘before group’ used the Status Quo method, and the ‘after group’ was taught by the author using the professional ‘Learning Goal’ approach. Additionally, a built-in bias mitigation was that one of the paired-groups was taught by the author using the Status Quo method, while the other was taught by the author using a Learning Goal approach. Since earlier tests were significant, the assumption of equal variances is set for the experiment.

#### 4.5.1. Pair-Wise Grouping Configuration

The results of this testing configuration can be better appreciated if the subgroup data is shown with matching group pairs highlighted. Table 4.11 lists the subset of the course sample data, with color-coding to visually match the pairing design (the survey instrument is attached in Appendix 2 and the source data is provided in Appendix 3).
The ‘Course#’ column can be traced back to previous statistical analysis to determine, to a partial extent, which courses used particular teaching modes.

The ‘Method’ column is coded slightly different in this subset, since in the original data the values were either ‘0’ meaning ‘Status Quo’ method was applied, or ‘1’ meaning learning goal approach was utilized. Here ‘Method’ was transfigured to provide three ordinals for sorting the rows, with ‘1’ referring to Status Quo being taught by an instructor other than the author, ‘33’ signifying the author applied a Status Quo (lassiez-faire) mode, and ‘99’ denoting that the author taught the course and applied the Learning Goal Approach. Also note that there were no outliers in any of the sample data variables.

‘Gender’ is arbitrarily coded as ‘1’ for male, and ‘2’ for female. ‘Yrs Exp’ column refer to the years of professional work experience. Each student was given a ‘Pseudo Name’ in the original sample dataset (indexed to the unique primary key of ‘Student#’), to make it easier to ‘work with the data’, verify the accuracy of the analysis at all times, yet maintain the confidentiality of the university and student information.

The planned treatment group comparisons are identified in the ‘Grp’ column, whereby ‘P1’ is the first matching, and ‘P2’ the second. For example, the first paired treatment would be with ‘Amy’, which compares her ‘GPV’ and ‘Satisfaction’ results between courses ‘LEOB6202’ (Status Quo taught by the author) and ‘LKMS610’ (author applied Learning Goals approach). Additional testing on the remaining paired students (blank ‘Grp’ cells) did not provide further value, but were included for completeness.

The enhancements in Table 4.11 are done to ease visual comparison. The color shading refers to the course, while the ‘Method’ column value corresponds to parenthesized number beside the course code listed in the analysis tables of the following subsection.
### Table 4.11: Paired Treatment Group Source Data Subset

<table>
<thead>
<tr>
<th>Course#</th>
<th>Student#</th>
<th>Age</th>
<th>Yrs. Exp.</th>
<th>Gender</th>
<th>Method</th>
<th>GPV</th>
<th>Satisfaction</th>
<th>Pseudo Name</th>
<th>Grp</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEOB6206</td>
<td>LAM078</td>
<td>28</td>
<td>6</td>
<td>2</td>
<td>33</td>
<td>3.612</td>
<td>5 Amy</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LEB080</td>
<td>31</td>
<td>11</td>
<td>1</td>
<td>33</td>
<td>3.184</td>
<td>3 Eric</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LRF082</td>
<td>32</td>
<td>10</td>
<td>1</td>
<td>33</td>
<td>3.504</td>
<td>4 Rob</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LSM079</td>
<td>26</td>
<td>6</td>
<td>1</td>
<td>33</td>
<td>3.622</td>
<td>4 Steve</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LSN081</td>
<td>39</td>
<td>19</td>
<td>1</td>
<td>33</td>
<td>3.38</td>
<td>4 Scott</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LAM078</td>
<td>28</td>
<td>6</td>
<td>2</td>
<td>99</td>
<td>3.428</td>
<td>5 Amy</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LEB080</td>
<td>31</td>
<td>11</td>
<td>1</td>
<td>99</td>
<td>3.464</td>
<td>4 Eric</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LRF082</td>
<td>32</td>
<td>10</td>
<td>1</td>
<td>99</td>
<td>3.748</td>
<td>5 Rob</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LSM079</td>
<td>26</td>
<td>6</td>
<td>1</td>
<td>99</td>
<td>3.5</td>
<td>5 Steve</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LSN081</td>
<td>39</td>
<td>19</td>
<td>1</td>
<td>99</td>
<td>3.616</td>
<td>5 Scott</td>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LYB505</td>
<td>24</td>
<td>4</td>
<td>2</td>
<td>33</td>
<td>3.088</td>
<td>3 Shanadeca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LYI550</td>
<td>30</td>
<td>7</td>
<td>1</td>
<td>33</td>
<td>3.32</td>
<td>4 Elmer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LYM531</td>
<td>39</td>
<td>17</td>
<td>2</td>
<td>33</td>
<td>2.8</td>
<td>3 Francine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>LYR502</td>
<td>36</td>
<td>14</td>
<td>1</td>
<td>33</td>
<td>3.062</td>
<td>4 Jack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LHY140</td>
<td>39</td>
<td>16</td>
<td>1</td>
<td>99</td>
<td>3.76</td>
<td>5 Hisham</td>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LIC250</td>
<td>30</td>
<td>7</td>
<td>1</td>
<td>99</td>
<td>3.604</td>
<td>5 Ihab</td>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>LRB167</td>
<td>44</td>
<td>20</td>
<td>1</td>
<td>99</td>
<td>3.79</td>
<td>5 Rene</td>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>LKOB6206</td>
<td>LHY140</td>
<td>39</td>
<td>16</td>
<td>1</td>
<td>99</td>
<td>3.726</td>
<td>5 Hisham</td>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>LKOB6206</td>
<td>LIC250</td>
<td>30</td>
<td>7</td>
<td>1</td>
<td>99</td>
<td>3.45</td>
<td>5 Ihab</td>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>LKOB6206</td>
<td>LRB167</td>
<td>44</td>
<td>20</td>
<td>1</td>
<td>99</td>
<td>3.774</td>
<td>5 Rene</td>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>LSOB6206</td>
<td>LYB505</td>
<td>24</td>
<td>4</td>
<td>2</td>
<td>11</td>
<td>3.44</td>
<td>3 Shanadeca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSOB6206</td>
<td>LYI550</td>
<td>30</td>
<td>7</td>
<td>1</td>
<td>11</td>
<td>3.08</td>
<td>4 Elmer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSOB6206</td>
<td>LYM531</td>
<td>39</td>
<td>17</td>
<td>2</td>
<td>11</td>
<td>3.56</td>
<td>3 Francine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSOB6206</td>
<td>LYR502</td>
<td>36</td>
<td>14</td>
<td>1</td>
<td>11</td>
<td>2.84</td>
<td>3 Jack</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

##### 4.5.2. Parametric T-Tests Across Courses

The first pair-wise *t-test* compared the Satisfaction level from two courses “LEOB6206” (taught by the author using Status Quo mode=33) against “LKMS6103” (learning goal approach applied by author=99). The −4 *t-statistic* \((p=0.008065)\) in Table 4.12 statistically proves the learning goal approach results in higher satisfaction \((H_0\) rejected at 5% level).
Furthermore, the Pearson Correlation test-statistic indicates that approximately 79% of the variance in satisfaction levels by the same students are explained by the teaching method (a relatively high and significant figure).

The second paired t-test compared GPV level from the same two courses ‘LEOB6206’ against ‘LKMS6103’ but the result was not-statistically significant, with a t-statistic of -0.905403 (p=0.2082281) as shown in Table 4.13 (H₀ accepted at 5% level).

The reader will realize that the one-tailed testing approach has been employed here to ascertain the direction of the variation (determine if one method is greater versus just different). All the tables demonstrate a two-way test would reach the same conclusions.
The results of the next two pair-wise *t-tests* in Table 4.14 and Table 4.15 were done to compare the Satisfaction level, and GPV score, from two courses ‘LKMS6103” and ‘LKOB6206” both taught by the author using the Learning Goal approach.

### Table 4.14: Same Teacher, Same Method Paired Validity T-Test of Satisfaction

<table>
<thead>
<tr>
<th>Paired T-Test P2</th>
<th>Satisfaction</th>
<th>$H_0$: $\mu_{SQ} = \mu_{LG}$</th>
<th>$H_1$: $\mu_{SQ} &lt; \mu_{LG}$</th>
<th>$\alpha = 5%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
<td>LKMS6103 (99)</td>
<td>LKOB6206 (99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>$P(T\leq t)$ one-tail</td>
<td>Est. &gt; 0.9973</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>$T$ Critical one-tail</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Df</td>
<td>2</td>
<td>$P(T\leq t)$ two-tail</td>
<td>Est. &gt; 0.9973</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>NA</td>
<td>$T$ Critical two-tail</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

The decision rule for these two particular tests was scientifically structured to logically seek the acceptance of the null hypothesis (of equivalent means), because it was desired to see no statistical significant difference in the results of the Learning Goal mode across courses.

### Table 4.15: Same Teacher, Same Method Paired Validity T-Test of GPV

<table>
<thead>
<tr>
<th>Paired T-Test P2</th>
<th>GPV</th>
<th>$H_0$: $\mu_{SQ} = \mu_{LG}$</th>
<th>$H_1$: $\mu_{SQ} &lt; \mu_{LG}$</th>
<th>$\alpha = 5%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
<td>LKMS6103 (99)</td>
<td>LKOB6206 (99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.718</td>
<td>3.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>0.009972</td>
<td>0.030576</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>0.9999143</td>
<td>$P(T\leq t)$ one-tail</td>
<td>0.1284985</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td>$T$ Critical one-tail</td>
<td>2.9199873</td>
<td></td>
</tr>
<tr>
<td>Df</td>
<td>2</td>
<td>$P(T\leq t)$ two-tail</td>
<td>0.256997</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>1.5699741</td>
<td>$T$ Critical two-tail</td>
<td>4.3026557</td>
<td></td>
</tr>
</tbody>
</table>

The purpose of these tests was to establish an experiment validity cross-reference to prove there was not any difference between the paired-groups (which there should not be if this is a normal distribution), since all other factors except the course were held constant. Here the goal was to uphold the null hypothesis. In both these last two *paired t-tests*, the results were as desired, with Table 4.14 and Table 4.15 both resulting in $H_0$
being accepted at the 5% significance level (sl). The Pearson Correlation statistics simply confirms a high correlation and is therefore not useful to further interpret here.

4.5.3. Nonparametric H-Tests Across Courses

From a pragmatic philosophical standpoint, distribution free tests were used earlier in the independent group analysis as a conservative approach in case my assumptions of a normal distribution were unknowingly violated. Although the last pair-wise t-test in Table 4.14 and Table 4.15 were strategically undertaken to validate normalcy between the paired groupings, the Kruskal-Wallis procedure is used here to further test the aforementioned findings, using a nonparametric variation, at the group level of analysis.

To achieve this, the $H$-test is applied to GPV scores and Satisfaction levels, using the same four course groups as with the Wilcoxon Rank-Sum Test from a previous sub section. These types of nonparametric tests are conservative since they evaluate the sample population medians without relying on the student $t$ distribution.

However, what is different here with the Kruskal-Wallis $H$-test (as compared with the Wilcoxon Rank-Sum Test) is that I compare the four course groups without combining the two course results for the same teaching methods together (the process of transfiguring four courses into two groupings), which was a necessary (and purposeful) configuration to execute the Wilcoxon procedures (reported in Table 4.7 and Table 4.8). This does not overcome small group sizes but it is a strong mathematical tactic.

The first Kruskal-Wallis $H$-test compared the Satisfaction level between all four courses. This produced an $H$ statistic of 18.91523 ($p=0.000285$) as displayed in Table 4.16 that was statistically significant ($H_0$ rejected at the 5% significance level).
Table 4.16: H-test for Satisfaction Level Variances between Courses

<table>
<thead>
<tr>
<th>Kruskal-Wallis H-Test</th>
<th>Satisfaction</th>
<th>( H_0: \mu_1=\mu_2=\mu_3=\mu_4 )</th>
<th>( H_1: \mu_i&lt;&gt;\mu_j&lt;&gt;\mu_k&lt;&gt;\mu_d )</th>
<th>( \alpha = 5% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>Sample Size</td>
<td>Sum of Ranks</td>
<td>Mean Ranks</td>
<td></td>
</tr>
<tr>
<td>LSOB6206</td>
<td>17</td>
<td>276.5</td>
<td>16.2647059</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>9</td>
<td>150.5</td>
<td>16.7222222</td>
<td></td>
</tr>
<tr>
<td>LKOB6206</td>
<td>12</td>
<td>414</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>10</td>
<td>335</td>
<td>33.5</td>
<td></td>
</tr>
<tr>
<td>Sum of Squared Ranks/Sample Size</td>
<td>32519.39</td>
<td>H Test Statistic</td>
<td>\textbf{18.91523}</td>
<td></td>
</tr>
<tr>
<td>Sum of Sample Sizes</td>
<td>48</td>
<td>Critical Value</td>
<td>7.814725</td>
<td></td>
</tr>
<tr>
<td>Number of Groups</td>
<td>4</td>
<td>p-Value</td>
<td>\textbf{0.000285}</td>
<td></td>
</tr>
</tbody>
</table>

The second *Kruskal-Wallis H-test* compared the GPV scores between all four courses, and it again produced a statistically significant result, with an *H statistic* of 8.373533 \( (p=0.038891) \), as listed in Table 4.17. \( H_0 \) was again rejected at 5\% level of significance.

Table 4.17: H-test for GPV Score Variances between Courses

<table>
<thead>
<tr>
<th>Kruskal-Wallis H-Test</th>
<th>GPV</th>
<th>( H_0: \mu_1=\mu_2=\mu_3=\mu_4 )</th>
<th>( H_1: \mu_i&lt;&gt;\mu_j&lt;&gt;\mu_k&lt;&gt;\mu_d )</th>
<th>( \alpha = 5% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>Sample Size</td>
<td>Sum of Ranks</td>
<td>Mean Ranks</td>
<td></td>
</tr>
<tr>
<td>LSOB6206</td>
<td>17</td>
<td>340</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>LEOB6206</td>
<td>9</td>
<td>159</td>
<td>17.6666667</td>
<td></td>
</tr>
<tr>
<td>LKOB6206</td>
<td>12</td>
<td>361.5</td>
<td>30.125</td>
<td></td>
</tr>
<tr>
<td>LKMS6103</td>
<td>10</td>
<td>315.5</td>
<td>31.5</td>
<td></td>
</tr>
<tr>
<td>Sum of Squared Ranks/Sample Size</td>
<td>30453.21</td>
<td>H Test Statistic</td>
<td>\textbf{8.373533}</td>
<td></td>
</tr>
<tr>
<td>Sum of Sample Sizes</td>
<td>48</td>
<td>Critical Value</td>
<td>7.814725</td>
<td></td>
</tr>
<tr>
<td>Number of Groups</td>
<td>4</td>
<td>p-Value</td>
<td>\textbf{0.038891}</td>
<td></td>
</tr>
</tbody>
</table>

4.6. Dependent Variable Relationships by Method Level of Analysis

At this point in the results analysis, there is statistically significant evidence in this experiment sample that applying a learning goal approach (as opposed to the lassiez-faire method) results in higher averaged Satisfaction levels and GPV scores. The next question is how strong is the relationship between the teaching method and the outcomes, and specifically how much higher are the outcomes per method? Secondly, is there a predictive pattern to this which could be emperically reduced to an algebraic formula?

Correlation and simple regression statistical techniques are accordingly applied here to analyze the linear relationships between the teaching method independent factor and the...
dependent variables (GPV and Satisfaction). Multiple regression and correlation is later examined to determine if there is a relationship (and the strength of it) between (and within) several of the independent factors, linked to the two dependent variables.

Table 4.18 indicates that the independent factor levels for teaching method have a statistically significant positive correlation \( r \sim +0.68 \) on the dependent variable Satisfaction \( (p=1.32548E-07, H_0 \) rejected at 5% level of significance). Approximately 46% of the satisfaction level variance is explained by the teaching method. By social research standards (Keppel and Wickens 2004, pp. 162-167), this is close to a medium effect (based on an \( r^2 \) scale 0.25 = small, 0.5 = medium, 0.8 = large). Furthermore, the Satisfaction coefficient of determination \( (r^2) \) in Table 4.18 is approximately equal to the between group effect size calculated with a single-factor ANOVA (refer to Table 4.4), which establishes a mathematical cross-reference between statistical methods. However, there is still about 54% of the variability unaccounted for, which suggests there are other independent factors in the context which directly or indirectly impact the cause/effect relationships. Scatter diagrams were produced to visually inspect the dependent variable regression residuals plotted against the method (as x-axis), but there were no patterns (following standard research practice, for example see: Aliaga and Gunderson 2003, p. 811).

The Durbin-Watson statistic of \( \sim 1.7 \) did imply possible auto-correlation on the x-axis (method). This value is close to 2 (the recommended benchmark), and since the sample data recording events were averaged to a point in time at the end of the course (not over time), this is acceptable. The purpose for examining the coefficient residuals is to determine if any of the independent variables are individually correlated, which can be signaled by residual errors which are linear or curvilinear across the x-axis, or a fanning out effect of residual errors as the x-axis increases. An illustrative plot of this was given in Figure 1.14: Regression Residual Multicollinearity Example from Chapter 3. A Durbin-Watson statistic close to 2 is preferred, while a value close to 0 or 4 indicates possible residual independence errors (this is mathematically important for simple regressions such as this with only one independent factor; hence it should be close to 2).
The most significant interpretation from Table 4.18 is the simple regression that proves the independent factor teaching method \( (t-test-statistic = 6.226154223) \) reliably predicts the outcome of satisfaction, as a linear equation. A resultant least squares mathematical equation to predict the course level satisfaction from applying a given teaching method is (coded 0=Status Quo or 1=Learning Goal approach): 3.769230769 + 0.958041958X. In the linear equation, the first parameter \( (\beta_0) \) is the estimated average satisfaction level when teaching method is Status Quo (zero); while the second parameter \( (\beta_1) \) represents the estimated average change in satisfaction when you apply the Learning Goal approach.

**Table 4.18: Regression and Correlation of Method with Satisfaction Level**

<table>
<thead>
<tr>
<th>Correlation</th>
<th>X=Teaching Method, Y=Satisfaction</th>
<th>( H_0: F &lt; F_{crit} )</th>
<th>( H_1: F =&gt; F_{crit} )</th>
<th>( \alpha = 5% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.67625673</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.457323165</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R</td>
<td>0.445525842</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square</td>
<td>0.531180412</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ANOVA**

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>1</td>
<td>10.9376</td>
<td>10.93765</td>
<td>38.76499</td>
<td>1.32548E-07</td>
</tr>
<tr>
<td>Residual</td>
<td>46</td>
<td>12.9790</td>
<td>0.2821526</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>23.9166</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Simple Regression**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept Y</td>
<td>3.769230769</td>
<td>0.10417</td>
<td>36.182398</td>
<td>1.91861E-35</td>
<td>3.5595414</td>
</tr>
<tr>
<td>( \beta_0 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method X</td>
<td>0.958041958</td>
<td>0.15387</td>
<td>6.226154</td>
<td>1.32548E-07</td>
<td>0.6483103</td>
</tr>
<tr>
<td>( \beta_1 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What does this equation mean from a mathematical interpolation? In the given context, there is a 95\% degree of confidence that the equation can estimate 46\% of satisfaction level trends for the teaching methods. For example, when the learning goal approach is used, we could predict an average satisfaction level of 4.7 in a sample survey (as compared with a level of 3.8 if a laissez-faire method is used). Obviously for a professor or university management, this is a very desirable scenario. Note that it is not proper to extrapolate this formula outside of the context inferred by Table 4.1 (e.g. try predicting with a third method or implementing another GPV evaluation scale).
The next result shows the simple regression applied to the GPV variable. Table 4.18 indicates that the independent factor levels for teaching method have a statistically significant positive correlation on average GPV score with \( r \sim +0.38 \). Approximately 15% of the GPV score variance is explained by the teaching method, nearly a small effect, leaving 85% of the variability unexplained. With an overall correlation \( F \)-statistic of 7.821597255 (\( p=0.00751113 \)), \( H_0 \) is consequently rejected at 5% level of significance. Likewise to the discussion above with Satisfaction, the GPV coefficient of determination \( (r^2) \) in Table 4.19 is very close to the between group effect size of 17% calculated earlier with the single-factor ANOVA (refer to Table 4.3), which serves as a mathematical cross-reference between the two different statistical analysis methods.

The independent factor level \( t \)-test-statistic of 2.796711865 was also significant (\( p=0.00751113 \)), which allows us to produce a least squares equation to predict course GPV score from a given method. The linear equation is: \( 3.287992928 + 0.002365267X \). The mathematical interpolation for application to this research theory is that in a given context, there is a 95% degree of confidence that the equation can estimate 15% of GPV scores for specific teaching methods. For example, to interpolate an application of this, if the learning goal approach is used, we could expect an average GPV score of 3.29.

**Table 4.19: Regression and Correlation of Method with GPV Score**

<table>
<thead>
<tr>
<th>Correlation</th>
<th>X=Teaching Method, Y=GPV Score</th>
<th>( H_0: F &lt; F_{crit} )</th>
<th>( H_1: F =&gt; F_{crit} )</th>
<th>( \alpha = 5% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.38121452</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.14532451</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.126744608</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.238984421</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ANOVA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
<td>1</td>
<td>0.446719212</td>
<td>0.446719212</td>
<td>7.8215</td>
</tr>
<tr>
<td>Residual</td>
<td>46</td>
<td>2.627223454</td>
<td>0.057113553</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>3.073942667</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Simple Regression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept Y</td>
<td>( \beta_0 )</td>
<td>3.287992928</td>
<td>0.058221494</td>
<td>56.47386702</td>
</tr>
<tr>
<td>Method X</td>
<td>( \beta_1 )</td>
<td>0.002365267</td>
<td>0.000845731</td>
<td>2.79671186</td>
</tr>
</tbody>
</table>
4.7. Dependent Variable Relationships by Contextual Level of Analysis

The previous subsection used one-way ANOVA F-Tests, t-tests, and the Durbin-Watson statistic, to measure the significance and strength of the relationship between teaching method (as the independent factor) and the dependent variables. All tests showed support for a positive correlation and regression, with stronger evidence towards a linear equation predicting satisfaction based on method. This subsection explores the effect of several independent factors in terms of how they interact with the dependent variables.

At this point it is desirable to establish a baseline multiple regression learning goal model of all factors and variables assumed to be relevant to the theory (those that are available from the sample data), without removing or adding anything. Subsequently, the model building exercise in the next sub section will leverage these findings to explore (and compare) new factorial designs.

The first contextual level to explore is the correlation between all independent factors and dependent variables, using Pearson’s Correlation. From glancing at the bolded statistics in Table 4.20, there are some obvious strong positive correlation between Age and Experience ($r \approx 0.973153548$), Satisfaction and Method ($r \approx 0.67625673$), GPV and Method ($r \approx 0.404194459$), and finally among GPV and Satisfaction ($r \approx 0.5652168$). The last correlation with the two dependent variables (GPV and Satisfaction) will be explored in a later subsection as part of multiple regression model-building using transfigured factors. Satisfaction also exhibited minor correlation with Age and Experience. The other independent factors did not show significant inter-correlation from this level of analysis.

Table 4.20: Correlation between Independent Factors & Dependent Variables

<table>
<thead>
<tr>
<th>Pearson’s Correlation</th>
<th>Age</th>
<th>Experience</th>
<th>Gender</th>
<th>Method</th>
<th>Satisfaction</th>
<th>GPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td>0.97315354</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>0.07865440</td>
<td>0.08044318</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.06238626</td>
<td>0.08326064</td>
<td>-0.1842570</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TeachingMethod</td>
<td>0.17903183</td>
<td>0.13129804</td>
<td>-0.1798733</td>
<td>0.676256</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>0.05915126</td>
<td>0.04223222</td>
<td>-0.0965480</td>
<td>0.404194</td>
<td>0.56521</td>
<td>1</td>
</tr>
<tr>
<td>GPV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The following analysis will explore a structured evaluation of correlation and multiple regression, at a more detailed level of analysis, to determine the effect of each independent factor on the variance of both dependent variables. This multiple regression and correlation analysis is configured as a two-way ANOVA factorial design, again using \( F \)-Tests, \( t \)-tests the Durbin-Watson statistic, as well as the Coefficient of Partial Determination, to measure the significance and strength of cause/effect variation between age, experience, gender, and method (as treatments), against the dependent variables (satisfaction and GPV score). The “Intercept” line explains the variations between the aggregate group level of analysis (students across courses), while the “X” rows examine the “within” interaction of the independent factors.

Table 4.21 reveals strong support towards the research propositions with an \( F \)-statistic of 12.81417081 (p-value=5.96183E-07) which is significant at the 5% level (\( H_0 \) rejected). The Pearson Correlation statistic is also strong and positive (\( r \sim +0.74 \)). The coefficient of multiple determination is approximately 54%, which is slightly higher than a medium effect, leaving an unexplained effect variation of 46%. Micro-level analysis of the independent factor interactions show some interesting and supportive findings, namely that age (\( t \)-test-statistic = 2.689294046, p-value=0.010149676), experience (\( t \)-test-statistic = -2.434873944, p-value=0.019120422), and method (\( t \)-test-statistic = 6.442286755, p-value=8.30595E-08), all are significant. A benchmark \( t \)-test-statistic for multiple regression in this type of-statistical procedure is > ±2 (Carlson and Thorne 1997, p. 106).

The Durbin-Watson Statistic of 1.838594283 indicates no abnormal correlation within the multiple regression residuals. These results indicate that all independent variables except gender have a strong interaction effect on the dependent variable satisfaction. Also this accords an improvement to the simple regression on satisfaction: 54% effect is now explained as compared with about 46%, \( (adjusted r^2=0.445525842, \) see Table 4.18).
Table 4.21: Multiple Variable Regression and Correlation with Satisfaction

<table>
<thead>
<tr>
<th>Correlation</th>
<th>X=Teaching Method, Y=Satisfaction</th>
<th>H_0: F &lt; F_{crit}</th>
<th>H_1: F =&gt; F_{crit}</th>
<th>\alpha = 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.737427235 • = b_0 + [b_1 \cdot X_1] + [b_2 \cdot X_2] + [b_3 \cdot X_3] + [b_4 \cdot X_4]</td>
<td>\text{Durbin-Watson Auto-correlation Test}</td>
<td>\text{Sum of Squared Difference of Residuals}</td>
<td>20.06055102</td>
</tr>
<tr>
<td>R Square</td>
<td>0.543798927</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.501361618</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.503725862</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANOVA</td>
<td>Df</td>
<td>SS</td>
<td>MS</td>
<td>F</td>
</tr>
<tr>
<td>Regression</td>
<td>4</td>
<td>13.0058</td>
<td>3.2514644</td>
<td>12.81417</td>
</tr>
<tr>
<td>Residual</td>
<td>43</td>
<td>10.9108</td>
<td>0.2537397</td>
<td>1.838594</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>23.9166</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The simple regression and one-way ANOVA analysis in the previous subsection examined the linear cause/effect of a single factor (method) on each of the dependent variables (satisfaction and GPV). In this subsection we are examining multiple regression of independent factors simultaneously (given that the simple regression was statistically significant), as such it is necessary to add a new integrity test to assess their possible uncontrolled interaction.

The Variance Inflationary Factor (VIF) was therefore calculated to measure the multicollinearity (combined linear association) for each of the independent X factors (but in the context of all being applied and held constant), on the dependent variable satisfaction (and the same process will be repeated for the GPV).

As explained earlier in Chapter 3, higher VIF-statistics indicate more collinearity (an undesirable effect). Consequently, for this analysis the benchmark is a VIF less than or
equal to 10. The results in Table 4.22 indicate desirable VIF indicators for the gender and method independent factors, but imply the age and experience may have heteroscedasticity (multicollinearity) effects.

Table 4.22: Variance Inflationary Factor Collinearity on Satisfaction

<table>
<thead>
<tr>
<th>Regression VIF</th>
<th>Age</th>
<th>Experience</th>
<th>Gender</th>
<th>Teaching Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.97338821</td>
<td>0.973451683</td>
<td>0.208292095</td>
<td>0.223924109</td>
</tr>
<tr>
<td>R Square</td>
<td>0.947388461</td>
<td>0.947608179</td>
<td>0.043385597</td>
<td>0.050142007</td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.94380131</td>
<td>0.944036009</td>
<td>-0.021838113</td>
<td>-0.014621038</td>
</tr>
<tr>
<td>Standard Error</td>
<td>1.532046728</td>
<td>1.410672235</td>
<td>0.453970047</td>
<td>0.507201347</td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>VIF</td>
<td><strong>19.00723703</strong></td>
<td><strong>19.08694871</strong></td>
<td><strong>1.045353276</strong></td>
<td><strong>1.052788951</strong></td>
</tr>
</tbody>
</table>

The next step in this analysis is to examine the multiple regression to determine what degree of variation in the dependent variable is explained by each independent factor, given that all would be used and held constant in the model. The numbers in Table 4.23 report the calculations and resulting four coefficient of partial determination statistics (cpr²) for each independent factor. The most important result is the bolded item which illustrates that the forth independent factor “method” contributed significantly more to the model, explaining over 49% of the variation in satisfaction (while the other factors were also included but held constant). This again emphasizes method as the key factor. Also it shows gender makes very little difference to the model, yet age, and experience do contribute to the variation of satisfaction (but to a much lessor degree than method).

Table 4.23: Multiple Regression Coefficients of Partial Determination on Satisfaction

<table>
<thead>
<tr>
<th>Coefficients of Partial Determination</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SSR(X1,X2,X3,X4)</td>
<td>13.00585768</td>
</tr>
<tr>
<td>SST</td>
<td>23.91666666</td>
</tr>
<tr>
<td>SSR(X2,X3,X4)</td>
<td>11.1707351</td>
</tr>
<tr>
<td>SSR(X1,X3,X4)</td>
<td>11.5015334</td>
</tr>
<tr>
<td>SSR(X1,X2,X4)</td>
<td>12.9199776</td>
</tr>
<tr>
<td>SSR(X1,X2,X3)</td>
<td>2.47488221</td>
</tr>
<tr>
<td>Y=Satisfaction, X1=Age, X2=Experience, X3=Gender, X4=Method</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coefficients</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>r² Y1.234</td>
<td>0.143977124</td>
</tr>
<tr>
<td>r² Y2.134</td>
<td>0.121168596</td>
</tr>
<tr>
<td>r² Y3.124</td>
<td>0.007809629</td>
</tr>
<tr>
<td>r² Y4.123</td>
<td>0.491142679</td>
</tr>
</tbody>
</table>
Although it would be possible to create a multiple regression linear equation, this would not be useful at this point since the gender factor is not deemed statistically significant in the model, it should be removed from the ANOVA2 analysis, before proceeding with the model building sub section. Additionally, showing the linear regression equation will not serve the underlying purposes of this dissertation since it would allow the prediction of an outcome, but the aim of this research is to build a theoretical model with empirical results that indicate teaching method correlation and cause-effect on GPV and satisfaction.

The results for the multiple regression on satisfaction are very positive, yet the same analysis on the GPV variable does not reveal as much statistically significant information. The ensuing Table 4.24 GPV results do not exhibit much overall support towards the research propositions. The $F$-statistic of 2.062727593 ($p$-value=0.102435096) is not significant at the 5% level ($H_0$ accepted). The reason for this is attributed to including gender as a factor (removing gender makes this the multiple regression statistically significant as will be shown in the upcoming subsection). The only other figure worth highlighting in terms of independent factor effect on GPV score, is the method did in fact show a significant cause/effect in the multiple regression analysis ($t$-test-statistic $= 2.70695346$, $p$-value $= 0.009700875$).

The Durbin-Watson Statistic of 1.666343185 indicates no unusual correlation of multiple regression residuals. This model explains about 16% (but lower adjusted $r^2=0.082943119$) of the cause/effect variation on GPV, which is only slightly more as compared with 15% (adjusted $r^2=0.126744608$) in the simple regression (see Table 4.19).
Table 4.24: Multiple Variable Regression and Correlation with GPV

<table>
<thead>
<tr>
<th>Correlation</th>
<th>X=Teaching Method, Y=GPV Score</th>
<th>$H_0$: $F &lt; F_{crit}$</th>
<th>$H_1$: $F =&gt; F_{crit}$</th>
<th>$\alpha = 5%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.401236231 $\bullet = \beta_0 + (\beta_1 \cdot X_1) + (\beta_2 \cdot X_2) + (\beta_3 \cdot X_3) + (\beta_4 \cdot X_4)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.160990513</td>
<td>Durbin-Watson Auto-correlation Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.082943119</td>
<td>Sum of Squared Difference of Residuals</td>
<td>4.297610817</td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.244904683</td>
<td>Sum of Squared Residuals</td>
<td>2.579067059</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td>Durbin-Watson Statistic</td>
<td>1.666343</td>
<td></td>
</tr>
</tbody>
</table>

**ANOVA**

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4</td>
<td>0.49487</td>
<td>0.1237189</td>
<td>2.062727</td>
<td>0.102435</td>
</tr>
<tr>
<td>Residual</td>
<td>43</td>
<td>2.57906</td>
<td>0.0599783</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>3.07394</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Multiple Regression**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.860467428</td>
<td>0.531807</td>
<td>5.3787622</td>
<td>2.90377E-06</td>
<td>1.7879756</td>
</tr>
<tr>
<td>$\beta_0$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.020499802</td>
<td>0.024155</td>
<td>0.8486740</td>
<td>0.4007626</td>
<td>-0.0282135</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>-0.020366053</td>
<td>0.026211</td>
<td>-0.7769982</td>
<td>0.4414135</td>
<td>-0.0732259</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>-0.015860138</td>
<td>0.081262</td>
<td>-0.1951712</td>
<td>0.8461781</td>
<td>-0.1797418</td>
</tr>
<tr>
<td>Method $X_4$</td>
<td>0.002404159</td>
<td>0.000888</td>
<td>2.7069534</td>
<td>0.0097008</td>
<td>0.0006130</td>
</tr>
<tr>
<td>$\beta_4$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The **VIF-statistics** for GPV scores in Table 4.25 practically mirror the **VIF** results analyzed previously on satisfaction. Gender and method are good, but age and experience independent variable factors may exhibit heteroscedasticity (multicollinearity) effects.

Table 4.25: Variance Inflationary Factor Collinearity on GPV Scores

<table>
<thead>
<tr>
<th>Regression</th>
<th>VIF</th>
<th>Age</th>
<th>Experience</th>
<th>Gender</th>
<th>Teaching Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.973464228</td>
<td>0.973531151</td>
<td>0.204528385</td>
<td>0.218498067</td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.947632602</td>
<td>0.947762902</td>
<td>0.04183186</td>
<td>0.047741405</td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.944062098</td>
<td>0.944201282</td>
<td>-0.023497786</td>
<td>-0.017185317</td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>1.528487892</td>
<td>1.408587705</td>
<td>0.454338567</td>
<td>41.57079652</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>VIF</td>
<td>19.0958506</td>
<td>19.14348301</td>
<td>1.043658162</td>
<td>1.050134917</td>
<td></td>
</tr>
</tbody>
</table>

There is only one small **coefficient of partial determination** statistic to mention from Table 4.23. The bolded items are of statistical interest as they may be able to explain a combined cause-effect for the professional learning goal system model. Percentages between 10% and 20% (or higher) would be considered significant for human behavior type studies (Carlson and Thorne 1997, p. 647) such as this analysis. The independent
factor “Method” again stood out as the only real significant effect, accounting for approximately 15% of the variation in GPV (while the other factors were also included but held constant). The satisfaction VIF conclusions (from above) also apply here.

As with the previous multiple regression analysis of the independent factors on satisfaction, this examination of GPV variation cause/effect showed that “method” is a significant factor, while “age” and “experience” are lessor but probable factors, while “gender” is not a factor. Therefore, “gender” will be removed from further analysis.

Table 4.26: Multiple Regression Coefficients of Partial Determination on Satisfaction

<table>
<thead>
<tr>
<th>Coefficients of Partial Determination</th>
<th>r² Y1.234</th>
<th>r² Y2.134</th>
<th>r² Y3.124</th>
<th>r² Y4.123</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSR(X1,X2,X3,X4)</td>
<td>0.494875608</td>
<td>Y=GPV,</td>
<td>0.016474006</td>
<td>0.145597991</td>
</tr>
<tr>
<td>SST</td>
<td>3.073942667</td>
<td>X1=Age, X2=Experience, X3=Gender, X4=Method</td>
<td>0.013845748</td>
<td>0.00885072</td>
</tr>
<tr>
<td>SSR(X2,X3,X4)</td>
<td>0.451676379</td>
<td>SSR(X1</td>
<td>X2,X3,X4)</td>
<td>0.043199229</td>
</tr>
<tr>
<td>SSR(X1,X3,X4)</td>
<td>0.458665135</td>
<td>SSR(X2</td>
<td>X1,X3,X4)</td>
<td>0.036210474</td>
</tr>
<tr>
<td>SSR(X1,X2,X4)</td>
<td>0.492590926</td>
<td>SSR(X3</td>
<td>X1,X2,X4)</td>
<td>0.002284682</td>
</tr>
<tr>
<td>SSR(X1,X2,X3)</td>
<td>0.055378768</td>
<td>SSR(X4</td>
<td>X1,X2,X3)</td>
<td>0.43949684</td>
</tr>
</tbody>
</table>

The next question which arises from the multiple regression analysis is, what are the other unknown factors accounting for the unexplained variation of 46% on satisfaction (in Table 4.21), as well as the 85% undefined variation on GPV (see Table 4.24). This query will be discussed in the subsection below.

4.8. Systemic Model Building using Variable Interactions

This section attempts to answer the unexplained variation from the multiple regression models for simultaneous treatment factor effect on satisfaction and GPV. A number of creative yet rational approaches are used, namely: transforming the variables, adding additional qualitative variables, and transfiguring a dependent variable into a factor. As mentioned in the previous subsection, the “gender” variable has been eliminated (note for the non mathematically-inclined, this has nothing to do with gender stereotyping).
What is common to these model-building exercises is the application of rationalistic thinking combined with empiricist-statistical quality assurance, but at the expense of tremendous effort and complexity. An experienced statistician will immediately acknowledge that there is a colossal amount of computations to execute, and a high volume of output to analyze, with these two-way ANOVA’s, correlation, multiple regressions, and the supporting integrity checks. As a matter of fact, this exercise actually generated more than a single Excel spreadsheet could contain – there were hundreds of models to inspect.

With hundreds of statistical models to examine, the most reliable way to systematically evaluate their individual significance (once the integrity checks are proven) is to use the adjusted $r^2$ (explained earlier) in combination with Mallow’s C statistic. Mallow’s C is analogous to Tukey-Kramer HSD in the sense that the former compares multiple regression and two-way ANOVA models for a significant effect, while the latter compares one-way ANOVA independent group variations to determine the difference. The goal of the comparing adjusted $r^2$ and Mallow’s C statistic in complex factorial designs with multiple regression is to identify a ‘difference’ between all single combinations of regression model iterations (for a given group of independent treatment factors). The differences are compared against an hypothesized true model that contains no unexplained variability (using an algorithm that includes residual errors as a factor).

The next exercise reports only the significant multiple regression models (those with the highest overall adjusted $r^2$ and Mallow’s C statistic), along with the supporting statistical integrity evidence. The chain of evidence can be seen in the aforementioned tables, and these results can be replicated using actual sample data in Appendix 3.

### 4.8.1. Independent Factor Transformations

The first approach to expand the model was to transform several key independent factors into different mathematical bases, as well as to combine some of them for interaction effect. The starting point for determining what numerical transformation and which interaction to create was based on pattern analysis of the scatter plots and
multiple regression residuals, as well as by using heuristics, to capture the unexplained variability.

One key transformed factor created was ‘Experience^Method’, because I hypothesized that a quadratic interactive effect might exist since it is logical to assume (and experience shows) that as project managers (and students in general) gain more work experience, their intellectual competencies expand (meaning they gain more tacit knowledge, skills, and ability to assess/decide which to apply in various situations). ‘Experience’ was chosen for the base instead of ‘age’ because it was deduced that the former is a better predictor of actual competency, rather than simply how old one is. For example, if a person has never worked, chances are that they may not have as much developed expertise applying knowledge, and continually learning, since they would not likely have the money or career motivation (unless of maybe they won the lottery and became an armchair philosopher). ‘Method’ was used as the exponent because it was hypothesized that project managers with more experience would have unknowingly applied goal-setting and self-regulation principles to advance their life and career. Additionally it is believed that project managers (and students in general) with more experience would likely acknowledge and more readily adapt to the application of a learning goal approach as they advance their education. The above deductions were actually derived from previous leadership research whereby it was shown that project management ability and experience were linked to performance and satisfaction (Strang 2005e), and also that performance outcomes in projects were significantly impacted by experience (Strang 2005g). The interaction of the two was estimated to be more influential than an exponent alone (for experience), since the multiple regression analyzed earlier did not produce a high enough t-test result to indicate this was any more significant than other factors such as age (see Table 4.21 and Table 4.24).

4.8.1.1. Multiple Regression Transformation Interaction on Satisfaction

Stepwise regression for numerous transformed interaction factor effect on Satisfaction scores produced abundant models with an overall statistically significant (medium effect) ‘best result’ summarized in Table 4.27. This particular model accounts for about 56% of the variation in Satisfaction (with adjusted $r^2 = 0.506993372$), and an overall $F$-
test-statistic of 10.6668079 (p-value=1.16438E-06), whereupon $H_0$ was rejected at 5% level. The Durbin-Watson Statistic of 1.9 was good (did not indicate residual autocorrelation).

The important finding was that the t-tests of several transformed interaction factors produced a significant result for the ‘intercept’ and ‘Method’ (as expected), along with ‘Exp*Meth’, and ‘Age*Exp*Meth’. Note that many possibilities of mathematical bases were attempted (exponential, logarithmic, reduction using division, addition, subtraction, etc.). This means that the interaction of the student’s age and experience, along with the Learning Goal approach, did account for about 56% of the variation in Satisfaction.

This Satisfaction transformed interaction model is a marginal improvement to the base multiple regression prototype from Table 4.21 (that accounted for about 54% of the cause/effect variation, with an adjusted $r^2 =0.501361618$). In reality, this model is still not good enough to make a significant contribution to the theoretical model.
Table 4.27: Transformed Interaction Multiple Regression on Satisfaction

<table>
<thead>
<tr>
<th>T-Correlation</th>
<th>X=Transformed Interaction Factors, $H_0$: $F &lt; F_{crit}$ $H_1$: $F =&gt; F_{crit}$ $\alpha = 5%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.74795781 $\cdot = \beta_0 + [\beta_1 \Delta \theta_1] + [\beta_2 \Delta \theta_2] + [\beta_3 \Delta \theta_3] + [\beta_4 \Delta \theta_4] + [\beta_5 \Delta \theta_5]$</td>
</tr>
<tr>
<td>R Square</td>
<td>0.559440886</td>
</tr>
<tr>
<td>Adjusted R</td>
<td>0.506993372</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.500873178</td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANOVA</th>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>$p$-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>5</td>
<td>13.3799</td>
<td>2.6759922</td>
<td>10.66668</td>
<td>1.16438E-06</td>
</tr>
<tr>
<td>Residual</td>
<td>42</td>
<td>10.5367</td>
<td>0.2508739</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>23.9166</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiple Regression</th>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.195130573</td>
<td>1.232182</td>
<td>0.1583617</td>
<td>0.8749307</td>
<td>-2.2915151</td>
<td>2.6817762</td>
</tr>
<tr>
<td>Age</td>
<td>0.156954373</td>
<td>0.057705</td>
<td>2.7199426</td>
<td>0.0094588</td>
<td>0.0405008</td>
<td>0.2734078</td>
</tr>
<tr>
<td>Experience</td>
<td>-0.144313348</td>
<td>0.063484</td>
<td>-2.273189</td>
<td>0.0281920</td>
<td>-0.2724312</td>
<td>-0.0161954</td>
</tr>
<tr>
<td>TeachingMethod</td>
<td>1.03798095</td>
<td>0.521914</td>
<td>1.9887962</td>
<td>0.0532645</td>
<td>-0.0152848</td>
<td>2.0912467</td>
</tr>
<tr>
<td>exp*meth</td>
<td>0.076443863</td>
<td>0.130288</td>
<td>0.5867296</td>
<td>0.5605260</td>
<td>-0.1864881</td>
<td>0.3393758</td>
</tr>
<tr>
<td>age<em>exp</em>meth</td>
<td>-0.002124351</td>
<td>0.002632</td>
<td>-0.8069509</td>
<td>0.4242049</td>
<td>-0.0074370</td>
<td>0.0031883</td>
</tr>
</tbody>
</table>

The coefficient of partial determination statistics do not add anything further to the analysis so they are not included here. Mallow’s $C$ and adjusted $r^2$ both indicated that the best model was the one reported above with all transformed interaction factors included. The VIF-statistics for Satisfaction score in Table 4.28 all show likelihood of multicollinearity for the model.

Table 4.28: Transformed Interaction VIF Collinearity on Satisfaction

<table>
<thead>
<tr>
<th>Txi-VIF</th>
<th>Age</th>
<th>Experience</th>
<th>Method</th>
<th>Exp*Meth</th>
<th>Age<em>Exp</em>Meth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mult.R</td>
<td>0.9806219</td>
<td>0.98120059</td>
<td>0.9605798</td>
<td>0.9976004</td>
<td>0.996533416</td>
</tr>
<tr>
<td>R Sq.</td>
<td>0.9616193</td>
<td>0.96275461</td>
<td>0.9227136</td>
<td>0.9952066</td>
<td>0.993078849</td>
</tr>
<tr>
<td>Adj.R$^2$</td>
<td>0.9580490</td>
<td>0.95928993</td>
<td>0.9155242</td>
<td>0.9947607</td>
<td>0.992435021</td>
</tr>
<tr>
<td>Std. Er</td>
<td>1.3236704</td>
<td>1.20315812</td>
<td>0.1463505</td>
<td>0.5862581</td>
<td>29.01445709</td>
</tr>
<tr>
<td>Size</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>VIF</td>
<td>26.054784</td>
<td>26.848965</td>
<td>12.938902</td>
<td>208.62311</td>
<td>144.4846384</td>
</tr>
</tbody>
</table>
4.8.1.2. *Multiple Regression Transformation Interaction on GPV Scores*

Stepwise regression for numerous transformed interaction variables on GPV scores produced abundant models with an overall statistically significant (medium effect) “best result” summarized in Table 4.29. This particular model accounts for about 28% of the variation in GPV (with *adjusted r*² = 0.196782797), and an overall *F-test-statistic* of 3.302936593 (*p*-value=0.013233898), whereupon *H₀* was rejected at the 5% level. The *Durbin-Watson Statistic* of 1.7 did not indicate any residual autocorrelation.

The important finding was that the *t-tests* of several transformed interaction factors produced a significant result for the “Intercept” and “Method” (as expected), along with “Age*Meth”, “Age*Exp*Meth”. Note that many possibilities of mathematical bases were attempted (exponential, logarithmic, reduction using division, addition, subtraction, etc.). This means that the interaction of the student’s age and experience, along with the Learning Goal approach, did account for about 28% of the variation in GPV scores. Deductively, this would leave 72% of the variation in GPV unexplained (as indicated with the previous 85% unexplained cause-effect variation shown in Table 4.24). This model is the most parsimonious (concise, clear, and simple) of the factorial generations as it requires only five factors in total.
Chapter 4: Results

Table 4.29: Transformed Interaction Multiple Regression on GPV

<table>
<thead>
<tr>
<th>T-Correlation</th>
<th>X=Transformed Interaction Factors, Y=GPV</th>
<th>H₀: F &lt; Fₐₚ</th>
<th>H₁: F =&gt; Fₐₚ</th>
<th>α = 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.531254586</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.282231435</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.196782797</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.229200443</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Durbin-Watson Auto-correlation Test**

| Sum of Squared Difference of Residuals | 3.7772547 |
| Sum of Squared Residuals              | 2.2063794 |
| Durbin-Watson Statistic               | 1.711969 |

**ANOVA**

<table>
<thead>
<tr>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.86756</td>
<td>0.1735126</td>
<td>3.3029365</td>
<td>0.013233</td>
</tr>
<tr>
<td>42</td>
<td>2.082347</td>
<td>0.0523528</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>3.07394</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Multiple Regression**

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.167427181</td>
<td>0.695074</td>
<td>5.9956580</td>
<td>4.02954E-07</td>
<td>2.7647102</td>
</tr>
<tr>
<td>Age</td>
<td>-0.037989025</td>
<td>0.032297</td>
<td>-1.1762330</td>
<td>0.2461257</td>
<td>-0.1031674</td>
</tr>
<tr>
<td>Experience</td>
<td>0.036687514</td>
<td>0.034337</td>
<td>1.0684482</td>
<td>0.2914210</td>
<td>-0.0326077</td>
</tr>
<tr>
<td>TeachingMethod</td>
<td>-2.648671512</td>
<td>1.155987</td>
<td>-2.291264</td>
<td>0.0270309</td>
<td>-0.9815485</td>
</tr>
<tr>
<td>Age*Meth</td>
<td>0.115182641</td>
<td>0.047323</td>
<td>2.4339646</td>
<td>0.0192674</td>
<td>0.019680</td>
</tr>
<tr>
<td>Age<em>Exp</em>Meth</td>
<td>-0.002329821</td>
<td>0.001033</td>
<td>-2.253568</td>
<td>0.0295026</td>
<td>-0.0044161</td>
</tr>
</tbody>
</table>

This GPV transformed interaction model is a dramatic improvement to the base multiple regression prototype from Table 4.24 (that could account for only about 16% of the effect, with an \( adjusted r^2 = 0.082943119 \), and it failed to be statistically significant). The VIF-statistics for Satisfaction effect in Table 4.30 all suggest factor multicollinearity.

Table 4.30: Transformed Interaction VIF Collinearity on GPV Scores

<table>
<thead>
<tr>
<th>Txl-VIF</th>
<th>Age</th>
<th>Experience</th>
<th>Method</th>
<th>Age*Meth</th>
<th>Age<em>Exp</em>Meth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mult.R</td>
<td>0.9870887</td>
<td>0.98657995</td>
<td>0.9983491</td>
<td>0.9992627</td>
<td>0.995290205</td>
</tr>
<tr>
<td>R Sq.</td>
<td>0.9743441</td>
<td>0.97334001</td>
<td>0.9967010</td>
<td>0.9985260</td>
<td>0.990602592</td>
</tr>
<tr>
<td>Adj R^2</td>
<td>0.9719576</td>
<td>0.97086001</td>
<td>0.9963942</td>
<td>0.9983889</td>
<td>0.989728415</td>
</tr>
<tr>
<td>Std. Er</td>
<td>1.0822222</td>
<td>1.017926561</td>
<td>0.0302362</td>
<td>0.7385985</td>
<td>33.80876582</td>
</tr>
<tr>
<td>Size</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>VIF</td>
<td>38.977527</td>
<td>37.5093960</td>
<td>303.13061</td>
<td>678.45535</td>
<td>106.4123264</td>
</tr>
</tbody>
</table>

The coefficient of partial determination statistics do not add anything further to the analysis so they are not included here. Mallow’s C and \( adjusted r^2 \) both indicated that
the best model was the one reported above with all transformed interaction factors included.

4.8.2. Transfiguring Dependent Variables to Factors

The interesting finding from the time-consuming stepwise multiple regression of the transformed independent factors on GPV was one particular residual analysis (shown in Figure 4.7) which illustrates a dependent variable interaction “Method*Satisfaction” introduced to the GPV multiple regression model. This can be seen as a linear pattern in Figure 4.7 where all 48 factor results tend to cluster about a theoretical rising line starting at about the 2.8 value on the x-axis, at approximately y-axis residual of −0.55, and ending around the 3.9 x-axis point, on y-axis residual of +0.35, with most of the values ‘clumped’ towards the middle portion of this linear phenomenon. As explained in Chapter 3, these residuals and the accompanying plot charts were calculated as part of the multiple regression methodology to analyze factor collinearity and variable interaction.

This provided a clue that satisfaction may only be a cause factor (instead of an effect variable), and also that it may interact with more than just the method to affect GPV. Subsequently, ‘satisfaction” will be explored as an independent factor to determine multiple regression cause/effect on GPV score. A logical reason for pursuing this is although high satisfaction is of course desired, ultimately, it is the high performance outcome which can make a large difference to a project manager in the field. Therefore, it is logical to maintain GPV score as the dependent variable for continued model building.
Stepwise GPV multiple regression for the transfigured dependent variable ‘Satisfaction’ transformed with other factors, produced numerous models with an overall statistically significant (medium effect) ‘best result’ summarized in Table 4.27. This model accounts for about 44% of the variation in GPV (with positive correlation = 0.662053035), and an overall $F$-test-statistic of 4.459170554 ($p$-value=0.000960932, $H_0$ rejected at 5% level). The Durbin-Watson Statistic of 1.8 did not indicate any serious residual autocorrelation, but the $t$-tests of factors failed to produce any significant factorial effects.
Table 4.31: Transfigured Satisfaction & Transformed Factor Regression on GPV

<table>
<thead>
<tr>
<th>T-Correlation</th>
<th>X=transformed factors, Y=GPV Score</th>
<th>H₀: F &lt; Fₗₑ │ H₁: F =&gt; Fₗₑ</th>
<th>α = 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.6620530355  [ \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.43831422</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.340019209</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.207761274</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Durbin-Watson Auto-correlation Test

| Sum of Squared Difference of Residuals | 3.1240412 |
| Sum of Squared Residuals | 1.7265898 |
| Durbin-Watson Statistic | 1.809370 |

ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>7</td>
<td>1.34735</td>
<td>0.1924789</td>
<td>4.459170</td>
<td>0.000960</td>
</tr>
<tr>
<td>Residual</td>
<td>40</td>
<td>1.72658</td>
<td>0.0431647</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>3.07394</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Multiple Regression

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>7.250724022</td>
<td>2.46441</td>
<td>2.94216958</td>
<td>0.0053999</td>
<td>2.2699594</td>
</tr>
<tr>
<td>Teaching</td>
<td>0.023572475</td>
<td>0.027024</td>
<td>0.87225095</td>
<td>0.38827734</td>
<td>-0.0310468</td>
</tr>
<tr>
<td>Method</td>
<td>-0.322421949</td>
<td>0.349484</td>
<td>-0.9225633</td>
<td>0.36176640</td>
<td>-1.0287569</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>-0.007008251</td>
<td>0.006561</td>
<td>-1.0680708</td>
<td>0.29189228</td>
<td>-0.0202697</td>
</tr>
<tr>
<td>Log(Meth*Sat)</td>
<td>-3.383723102</td>
<td>2.235200</td>
<td>-1.5138342</td>
<td>0.13793017</td>
<td>-7.9012300</td>
</tr>
<tr>
<td>Log(Meth*Sat)</td>
<td>0.826148118</td>
<td>0.579988</td>
<td>1.42442275</td>
<td>0.16207958</td>
<td>-0.3460509</td>
</tr>
<tr>
<td>Log(Exp*Meth)</td>
<td>0.004421996</td>
<td>0.003352</td>
<td>1.31909701</td>
<td>0.19463849</td>
<td>-0.0023532</td>
</tr>
<tr>
<td>Log(Age*Exp)</td>
<td>-0.187128291</td>
<td>0.182437</td>
<td>-1.0257109</td>
<td>0.31119102</td>
<td>-0.5558483</td>
</tr>
</tbody>
</table>

The VIF-statistics for GPV score in Table 4.28 all indicate possible multicollinearity.

Table 4.32: Transformed VIF Collinearity on GPV Scores

<table>
<thead>
<tr>
<th>T-VIF</th>
<th>Method</th>
<th>Satisfaction</th>
<th>Meth*Sat</th>
<th>Log (Meth*Sat)</th>
<th>Log (Meth^Sat)</th>
<th>Log (Exp*Meth)</th>
<th>Log (Age*Exp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MultiR</td>
<td>0.999629</td>
<td>0.992584</td>
<td>0.999745</td>
<td>0.999605</td>
<td>0.999808</td>
<td>0.982213</td>
<td>0.855758</td>
</tr>
<tr>
<td>R Sq.</td>
<td>0.999259</td>
<td>0.985223</td>
<td>0.999491</td>
<td>0.999211</td>
<td>0.999616</td>
<td>0.964742</td>
<td>0.732322</td>
</tr>
<tr>
<td>Adj R²</td>
<td>0.999151</td>
<td>0.983061</td>
<td>0.999417</td>
<td>0.999095</td>
<td>0.999560</td>
<td>0.959583</td>
<td>0.693149</td>
</tr>
<tr>
<td>Std. Er</td>
<td>1.200629</td>
<td>0.092841</td>
<td>4.944963</td>
<td>0.014516</td>
<td>0.055944</td>
<td>9.679012</td>
<td>0.177851</td>
</tr>
<tr>
<td>Size</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

There is only one coefficient of partial determination statistic point worth mentioning from the results summarized in Table 4.33 – none are significant for the model.
Table 4.33: Transformed Multiple Regression Coefficients on GPV

<table>
<thead>
<tr>
<th>Coefficients of Partial Determination</th>
<th>Y=GPV, X1=TeachingMethod, X2=Satisfaction, X3=Method<em>Satisfaction, X4=log(Meth</em>Sat), X5=log(Meth^Sat), X6=log(Exp^Meth), X7=log(Age*Exp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6,X7)</td>
<td>1.347352784</td>
</tr>
<tr>
<td>SST</td>
<td>3.073942667</td>
</tr>
<tr>
<td>SSR(X2,X3,X4,X5,X6,X7)</td>
<td>1.314512106</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6,X7)</td>
<td>1.298111502</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X5,X6,X7)</td>
<td>1.248432386</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X6,X7)</td>
<td>1.259772368</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X7)</td>
<td>1.272245393</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6)</td>
<td>1.301939886</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X7)</td>
<td>1.310614271</td>
</tr>
<tr>
<td>SSR(X2</td>
<td>X1,X3,X4,X5,X6,X7)</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X5,X6,X7)</td>
<td>1.259772368</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X6,X7)</td>
<td>1.259772368</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6)</td>
<td>1.272245393</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6)</td>
<td>1.301939886</td>
</tr>
</tbody>
</table>

R\(^2\) Y1.234567 0.018665515
R\(^2\) Y2.134567 0.020834754
R\(^2\) Y3.124567 0.027728583
R\(^2\) Y4.123567 0.054187807
R\(^2\) Y5.123467 0.048275741
R\(^2\) Y6.123457 0.04168702
R\(^2\) Y7.123456 0.025628006

The best model based on Mallows’ C (as explained in Chapter 3, zero is the best value) is the one listed in Table 4.34 as “\(X_1X_2X_3X_4X_5X_6X_7\)”, with adjusted \( r^2 \) of 0.340019209 \((\text{adjusted } r^2 \text{ indicates 44% of the GPV variance is explained by these transfigured and transformed factors})\). The best model based solely on the adjusted \( r^2 \) of 0.357429631 is the one indicated in Table 4.34 labeled as “\(X_3X_4X_5X_6X_7\)” (Mallows’ C = 1.11). However, the model with all the variables is more logical since it includes the “Method” variable as a factor. Despite the fact that we do not have a model with a high effect (at the 80% benchmark), this particular transformed version is a significant enhancement to the one reported in Table 4.29, since this one explains approximately 44% of the effect, while the earlier multiple regression model (with transformation applied but without satisfaction variable added) that accounted for about 28% of the variation in GPV. Deductively this also reduces the unexplained cause-effect variation from 72% (originally at 85%) to 56%.

Table 4.34: Best Model with Transfigured & Transformed Factors on GPV

<table>
<thead>
<tr>
<th>Best Model Multiple Regression</th>
<th>Variable</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2T</td>
<td>0.438314</td>
<td>X1</td>
</tr>
<tr>
<td>1 - R2T</td>
<td>0.561686</td>
<td>X2</td>
</tr>
<tr>
<td>N</td>
<td>48</td>
<td>X3</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>X4</td>
</tr>
<tr>
<td>n – T</td>
<td>40</td>
<td>X5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>X6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X7</td>
</tr>
</tbody>
</table>
The reverse logic was applied from the previous GPV analysis, to use Satisfaction as the outcome variable, while transfiguring and transforming GPV as a factor. Stepwise multiple regression for this also produced numerous models with an overall statistically significant (medium effect) ‘best result’ summarized in Table 4.35. This model accounts for about 66% of the variation in Satisfaction (with strong positive correlation $r^2 = 0.812374062$, adjusted $r^2 = 0.600443149$), and an overall F-test-statistic of 11.09004563 ($p$-value=1.06637E-07, $H_0$ rejected at 5% level). The Durbin-Watson Statistic of 1.8 did not indicate any serious residual autocorrelation, but the t-tests of factors failed to recognize any significant individual effects. Unexplained cause-effect variation is 36%.
Table 4.35: Transfigured & Transformed GPV Factor Regression on Satisfaction

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>Multiple R</td>
<td>0.659951616</td>
</tr>
<tr>
<td></td>
<td>Adjusted R Square</td>
<td>0.600443149</td>
</tr>
<tr>
<td></td>
<td>Standard Error</td>
<td>0.450910852</td>
</tr>
<tr>
<td></td>
<td>Observations</td>
<td>48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANOVA</th>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>7</td>
<td>7.8384282</td>
<td>2.254834689</td>
<td>11.09004563</td>
<td>1.06637E-07</td>
</tr>
<tr>
<td>Residual</td>
<td>40</td>
<td>8.132823846</td>
<td>0.203320596</td>
<td>1.65854523</td>
<td>0.31128116</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>23.91666667</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiple Regression</th>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-3.5452039</td>
<td>1.99284412</td>
<td>-1.7789669</td>
<td>0.08284550</td>
<td>-7.5728905</td>
<td>0.4284827</td>
</tr>
<tr>
<td>GPV</td>
<td>0.95713719</td>
<td>0.36055745</td>
<td>2.6564237</td>
<td>0.0113402</td>
<td>0.22842915</td>
<td>1.68584523</td>
</tr>
<tr>
<td>Age</td>
<td>0.18067704</td>
<td>0.06462112</td>
<td>2.7959438</td>
<td>0.0079134</td>
<td>0.05070929</td>
<td>0.31128116</td>
</tr>
<tr>
<td>Experience</td>
<td>-0.1647652</td>
<td>0.06848458</td>
<td>-2.4058648</td>
<td>0.0208476</td>
<td>-0.3031782</td>
<td>-0.0263523</td>
</tr>
<tr>
<td>TeachingMethod</td>
<td>3.46638721</td>
<td>2.83585574</td>
<td>1.22234257</td>
<td>0.22873212</td>
<td>-2.6508872</td>
<td>9.19786316</td>
</tr>
<tr>
<td>GPV*Met</td>
<td>0.32041364</td>
<td>0.65764539</td>
<td>0.48721339</td>
<td>0.62876659</td>
<td>-1.0087367</td>
<td>1.64956403</td>
</tr>
<tr>
<td>Age*Met</td>
<td>-0.1417828</td>
<td>0.10464493</td>
<td>-1.3548946</td>
<td>0.18305431</td>
<td>-0.3532780</td>
<td>0.06971236</td>
</tr>
<tr>
<td>Exp<em>Age</em>Met</td>
<td>0.00227906</td>
<td>0.00226021</td>
<td>1.00834262</td>
<td>0.31935104</td>
<td>-0.0022889</td>
<td>0.00684711</td>
</tr>
</tbody>
</table>

The VIF statistics for GPV score in Table 4.28 suggest possible factor multicollinearity.

Table 4.36: Transformed & Transfigured GPV VIF on Satisfaction

<table>
<thead>
<tr>
<th>T-VIF</th>
<th>GPV</th>
<th>Age</th>
<th>Experience</th>
<th>Teaching Method</th>
<th>GPV*Met</th>
<th>Age*Met</th>
<th>Exp<em>Age</em>Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mult.R</td>
<td>0.7008599</td>
<td>0.9875202</td>
<td>0.9869453</td>
<td>0.9989386</td>
<td>0.9984262</td>
<td>0.9994165</td>
<td>0.996188</td>
</tr>
<tr>
<td>R Sq.</td>
<td>0.4912046</td>
<td>0.9751962</td>
<td>0.9740611</td>
<td>0.9978784</td>
<td>0.9968549</td>
<td>0.998333</td>
<td>0.99239</td>
</tr>
<tr>
<td>Adj.R²</td>
<td>0.4167467</td>
<td>0.9715664</td>
<td>0.9702652</td>
<td>0.9975679</td>
<td>0.9963946</td>
<td>0.9986626</td>
<td>0.991277</td>
</tr>
<tr>
<td>Std. Er</td>
<td>0.1953113</td>
<td>1.0897433</td>
<td>1.0282630</td>
<td>0.0248321</td>
<td>0.1070796</td>
<td>0.6729465</td>
<td>31.15659</td>
</tr>
<tr>
<td>Size</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>VIF</td>
<td>1.965426</td>
<td>40.316552</td>
<td>38.552192</td>
<td>471.34802</td>
<td>317.9596</td>
<td>857.1595</td>
<td>131.4121</td>
</tr>
</tbody>
</table>

The only coefficient of partial determination statistic worth noting from the results summarized in Table 4.37 are the first three variable effects as bolded in the table.
Table 4.37: Transformed & Transfigured GPV Coefficients on Satisfaction

<table>
<thead>
<tr>
<th>Coefficients of Partial Determination</th>
<th>Y=Satisfaction, X1=GPV, X2=Age, X3=Experience, X4=Teaching Method, X5=GPV<em>Met, X6=Age</em>Met, X7=Exp*Age *Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6,X7)</td>
<td>15.78384</td>
</tr>
<tr>
<td>SST</td>
<td>23.91667</td>
</tr>
<tr>
<td>SSR(X2,X3,X4,X5,X6,X7)</td>
<td>14.35104</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6,X7)</td>
<td>14.19442</td>
</tr>
<tr>
<td>SSR(X1,X2,X4,X5,X6,X7)</td>
<td>14.60699</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X5,X6,X7)</td>
<td>15.48006</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X6,X7)</td>
<td>15.73558</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X7)</td>
<td>15.4106</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6)</td>
<td>15.57712</td>
</tr>
<tr>
<td>SSR(X1,X2,X3,X4,X5,X6,X7)</td>
<td>15.78384</td>
</tr>
<tr>
<td>SSR(X1</td>
<td>X2,X3,X4,X5,X6,X7)</td>
</tr>
<tr>
<td>SSR(X1</td>
<td>X2,X3,X4,X5,X6,X7)</td>
</tr>
<tr>
<td>SSR(X1</td>
<td>X2,X3,X4,X5,X6,X7)</td>
</tr>
<tr>
<td>SSR(X2</td>
<td>X1,X2,X4,X5,X6,X7)</td>
</tr>
<tr>
<td>SSR(X5</td>
<td>X1,X2,X3,X5,X6,X7)</td>
</tr>
<tr>
<td>SSR(X6</td>
<td>X1,X2,X3,X4,X5,X7)</td>
</tr>
<tr>
<td>SSR(X7</td>
<td>X1,X2,X3,X4,X5,X6)</td>
</tr>
</tbody>
</table>

Coefficients

\[ r^2 Y1.234567 = 0.149787 \]
\[ r^2 Y2.134567 = 0.163483 \]
\[ r^2 Y3.124567 = 0.126412 \]
\[ r^2 Y4.123567 = 0.036008 \]
\[ r^2 Y5.123467 = 0.005899 \]
\[ r^2 Y6.123457 = 0.04388 \]
\[ r^2 Y7.123456 = 0.024789 \]

Despite the fact that we do not have a model with a ‘high effect’ (at the 80% benchmark), this particular transformed version a significant enhancement to the one reported in Table 4.31, since this one captures much more of the variation (66%>44%).

4.8.3. Interjecting Additional Independent Context Variables

At this point it appears to be difficult to capture more than 66% of the variation affecting Satisfaction (leaving 34% cause-effect unaccounted for), and more than 44% effect explaining GPV scores (with 56% cause-effect unexplained). Could there be other unknown factors that can be added here to explain the unexplainable? There are several qualitative variables that have been coded from the email comments and from the additional questions on the surveys. However, these variables are not available for all students (all samples) since as noted the author was not the instructor for all courses.

Nevertheless, the author did interview each student, and subsequently coded an ethnographic variable to record his aggregate assessment of each student’s social environmental stability. This new variable was designed to reflect the context of the
student, on average, during the course. A simple three level scale was used to indicate, at the high end, 3 if the environment was very stable, 2 if there were minor disruptions (e.g. a few work assignments or family responsibilities that interfered with studying), and 1 if there were at least one significant event which disrupted the studying, such as a family problem, car break down, or other event which negatively impacted the student for more than a week during the course.

The insight into creating this variable was of course the knowledge of the student situations. For example, one student nicknamed Amy did have such a negative event in that she decided to buy a house, which was positive, but it disrupted her course work. This negative effect on what was otherwise a very bright and high-achieving student surfaced during the pair-wise analysis. This anomaly can be found in Table 4.11 (and Appendix 3) at the line for course “LKMS6103”, student# ‘LAM078”, with a GPV=3.428” (lower than all her other GPV’s), but her satisfaction level is consistently 5. This indicates that despite a high satisfaction on all the Learning Goal method courses, and high GPV scores on all other courses, she did score a lower GPV on this course.

This procedure is of course not scientific since it was done after the analysis had started, and as such, the author may not have been totally objective, or possibly the author could have unknowingly influenced the student’s response. Nevertheless, the analysis with this “Context Stability” factor appears below. This should be considered a prelude to further research that would scientifically gather this variable from a survey question.

Table 4.38 portrays Pearson’s Correlation analysis on the independent factors, the dependent variables, along with the “context stability” attribute. The last row applies to “context stability”, while the preceding rows in the table are cross-referenced (identical as expected) with the correlation reported earlier (in Table 4.20) since the formula reproduced them from the sample dataset as a quality assurance measure. The incremental results are that “context stability” displayed medium positive correlation with Method ($r\sim0.602797084$), with Satisfaction ($r\sim0.5526592$), and with GPV ($r\sim0.543229$).
There does not appear to be any significant or meaningful new correlation between the other variables, at the contextual level of analysis. Multiple regression is necessary to determine the cause/effect of each independent factor, with one exception, that the correlation between Context and Method is positive and moderately high. The correlation between Content and the dependent variables is also positive and moderately high, which suggests there may be some relationship between the uncontrollable situational factors of the professional learner that influences their learning performance and satisfaction level.

Table 4.38: Context Stability, Independent Factor & Dependent Variable Correlation

<table>
<thead>
<tr>
<th>Pearson's Correlation</th>
<th>Age</th>
<th>Experience</th>
<th>Gender</th>
<th>Method</th>
<th>Satisfaction</th>
<th>GPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>0.97315354</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.07865440</td>
<td>0.08044318</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TeachingMethod</td>
<td>0.06238626</td>
<td>0.08326064</td>
<td>-0.1842570</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>0.17903183</td>
<td>0.13129804</td>
<td>-0.1798733</td>
<td>0.6762567</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GPV</td>
<td>0.05915126</td>
<td>0.04223221</td>
<td>-0.0965480</td>
<td>0.4041944</td>
<td>0.565216</td>
<td>1</td>
</tr>
<tr>
<td>Context</td>
<td>0.06397198</td>
<td>0.08717558</td>
<td>-0.2136372</td>
<td>0.602797</td>
<td>0.55265</td>
<td>0.5432</td>
</tr>
</tbody>
</table>

Interestingly enough, a stepwise multiple regression, testing for this phenomena, did not enhance the model to a further degree (and thus no additional integrity calculations are reported here). As Table 4.39 illustrates, by bringing “context stability” into the model, along with GPV transfigured as a factor, about 63% of the variation in Satisfaction was explained, which is lower than the 66% ($r^2$) finding in Table 4.35.

Table 4.39: Transfigured GPV and Contextual Factor Regression on Satisfaction

<table>
<thead>
<tr>
<th>T-Correlation</th>
<th>X=transfigured+context, Y=Satisfaction</th>
<th>$H_0$: $F &lt; F_{crit}$</th>
<th>$H_1$: $F =&gt; F_{crit}$</th>
<th>$\alpha = 5%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.794115707 $\bullet = \beta_0 + [\beta_1 \cdot X_1] + [\beta_2 \cdot X_2] + [\beta_3 \cdot X_3] + [\beta_4 \cdot X_4] + [\beta_5 \cdot D_5] + [\beta_6 \cdot D_6] + [\beta_7 \cdot D_7] + [\beta_8 \cdot D_8] + [\beta_9 \cdot D_9] + [\beta_{10} \cdot D_{10}] + [\beta_{11} \cdot D_{11}]$</td>
<td>Durbin-Watson Auto-correlation Test</td>
<td>Sum of Squared Difference of Residuals</td>
<td>Durbin-Watson Statistic</td>
</tr>
<tr>
<td>R Square</td>
<td>0.630619756</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R</td>
<td>0.576564111</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.464189411</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANOVA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
<td>6</td>
<td>15.0823</td>
<td>2.5137204</td>
<td>11.66612</td>
</tr>
<tr>
<td>Residual</td>
<td>41</td>
<td>8.83434</td>
<td>0.2154718</td>
<td></td>
</tr>
</tbody>
</table>
Although the above model was statistically significant, and it had only six factors as compared with seven for the previous multiple regression alternatives, this particular instance will not be recommended further due to the fact it was build from the contextual variable that lacked the appropriate data collection rigor and control. It was included here as a brain storming exercise from action science experimentation to uncover potential future avenues to theoretically study and test.

4.9. Chapter Summary

The amount and complexity of these statistical tests can be daunting but they are produced here to illustrate the completeness of the research. This Chapter has presented strong statistical evidence using both parametric and nonparametric tests to show that the professional learning goal approach does result in increased GPV scores, and higher levels of satisfaction, in the quasi-experimental frame. Even at the basic analysis level, the standard deviations in Table 4.1: Descriptive Statistics show that the learning goal approach is having a positive effect on the outcomes, which is visually apparent in Figure 4.1: Scatter Diagram of Key Factors & Variables, Figure 4.2: Box Plots of Dependent Variables by Course, Figure 4.3: GPV Dependent Variable Histogram by Teaching Method, Figure 4.4: Satisfaction Dependent Variable Histogram by Teaching Method, Figure 4.5: Sample Distribution Polygon of GPV Scores, and Figure 4.6: Sample Distribution Polygon of Satisfaction Level.

The course level of analysis indicated overall statistical support that the professional learning goal approach was significant, namely as seen from Table 4.3: Single-Factor ANOVA between Method and GPV across Courses, Table 4.4: Single-Factor ANOVA between Method and Satisfaction across Courses, and this was especially evident in the
parametric results of Table 4.5: One-Tailed Student T-Test for GPV Variation between Methods and Table 4.6: One-Tailed Student T-Test for Satisfaction Variance between Methods. The nonparametric tests afforded the same support towards the positive effects of the professional learning goal approach, as seen in Table 4.7: Wilcoxon Rank-Sum Test for Satisfaction Variance between Methods and Table 4.8: Wilcoxon Rank-Sum Test for GPV Variance between Methods. The statistical evidence strongly pointed to the learning goal model from the results in Table 4.9: Tukey-Kramer Test to Isolate Satisfaction Mean Differences but the support was weaker in Table 4.10: Tukey-Kramer Test Isolating GPV Mean Differences.

The most powerful statistical test (and evidential) support for the positive effect of the professional learning goal approach was in the pair-wise design, as shown in Table 4.11: Paired Treatment Group Source Data Subset (shows the actual data), Table 4.12: Same Teacher, Different Methods Paired T-Test of Satisfaction, Table 4.13: Same Teacher, Different Methods Paired T-Test of GPV, Table 4.14: Same Teacher, Same Method Paired Validity T-Test of Satisfaction, Table 4.15: Same Teacher, Same Method Paired Validity T-Test of GPV. As noted earlier, some of these tests (Table 4.14 and Table 4.15) were structured to provide experimental validity, to ensure that the positive effects were not specifically caused by the instructor (author) regardless of method.

Two additional sets of tests were conducted as conservative nonparametric techniques to confirm the above, as shown in the results of Table 4.16: H-test for Satisfaction Level Variances between Courses, and Table 4.17: H-test for GPV Score Variances between Courses.

The simple correlation and regression established overall support that the professional learning goal approach made a positive difference in student learning outcomes, as shown in Table 4.18: Regression and Correlation of Method with Satisfaction Level, Table 4.19: Regression and Correlation of Method with GPV Score, and Table 4.2: Dependent Variable Summary Statistics by Course.

Multiple regression investigated the detailed cause-effect between the factors (including professional learning goal approach) and the outcome variables (GPV and Satisfaction),
as shown in Table 4.20: Correlation between Independent Factors & Dependent Variables and Table 4.21: Multiple Variable Regression and Correlation with Satisfaction. These tests produced a statistically significant result in all but one multiple regression interaction on GPV (which was attributed to the inclusion of the gender factor, later deemed insignificant), the latter was shown Table 4.24: Multiple Variable Regression and Correlation with GPV as explained within that subsection.

The more advanced model building exercises were voluminous but fruitful in that a very good statistical model was found using factors such as transfigured (outcome variables substituted as input factors) and transformed (mathematical expressions). The details supporting this were shown in Table 4.27: Transformed Interaction Multiple Regression on Satisfaction, Table 4.29: Transformed Interaction Multiple Regression on GPV, and Table 4.31: Transfigured Satisfaction & Transformed Factor Regression on GPV. The results of the step-wise model building exercises were also summarized in various tables, Table 4.33: Transformed Multiple Regression Coefficients on GPV, Table 4.34: Best Model with Transfigured & Transformed Factors on GPV, Table 4.35: Transfigured & Transformed GPV Factor Regression on Satisfaction, and finally Table 4.37: Transformed & Transfigured GPV Coefficients on Satisfaction. As explained earlier, only the best models were shown here (many iterations were done to uncover these results).

Overall, the model building exercise is considered successful since it was able to explain 54% of the direct, and 66% of the combined, cause-effect between the independent factors (including learning goal approach) on the dependent variables GPV and Satisfaction. According to the literature, the academic community would recognize such a high level of cause-effect finding in multiple regression factorial research design (Cohen 1992; Tamhane and Dunlop 2000; Zechmeister, Zechmeister and Shaughnessy 2001; Keppel and Wickens 2004). A similar professional online learning method study in the literature was able to explain 12% overall cause-effect between a learner-centered approach (four factors were identified) and satisfaction as an outcome variable, and specifically 32.3% accounted for a variance in the level of learning satisfaction.
(Stonebraker and Hazeltine 2004, p. 220). There are many other examples in the literature but the above study was resent and similar to this one.

The attempt to explain the ‘unknown variation’ using a contextual factor was not statistically reliable, although the correlation was proved in *Table 4.38: Context Stability, Independent Factor & Dependent Variable Correlation*. The model building exercise also attempted to explain the ‘unknown cause-effect’ in the experiment, but this test was not able to statistically isolate or attribute the contextual factor as a cause-effect, and this was confirmed in *Table 4.39: Transfigured GPV and Contextual Factor Regression on Satisfaction*.

The scientific conclusion of the results is that the professional learning goal approach as a model is statistically significant at the 95% confidence level, with most tests actually surpassing the 1% level of significance, so the alternative hypothesis (*H₁*) is supported. Additionally, correlation relationships and multiple regression cause-effect was found to be significant between the factors at 54% direct (Satisfaction) and 66% combined (including teaching method) to explained the variance in the dependent variable Satisfaction (leaving 34% cause-effect unaccounted for), and more than 44% effect explaining GPV scores (with 56% cause-effect unexplained).

These results can now be used in the following chapter to validate and correct the systemic professional learning goal model created in Chapter 2 (Figure 2.9: Professional Learning Goal Experimental Factor Model). Then these statistical results must be reflected back to the theoretical principles (of Figure 2.8: Synthesized Professional Learning Principles Model). Following that, inductive generalizations would be possible.
5. IMPLICATIONS AND CONCLUSIONS

5.1. Introduction
This final chapter presents a critical reflection of the empirical and phenomenological findings by comparing statistical interpretations of the results to the rationalized professional learning approaches. To accomplish that, this chapter integrates the strategic analysis themes of Chapter 1, with the theoretical explorations articulated in Chapter 2, to account for the empirical test results from Chapter 4. Key theoretical properties of the professional online learning models are highlighted from the quasi-experiment findings and collated with similar recent literature and empirical studies.

The results in Chapter 4 were scientifically presented with statistical interpretations, and here they are retraced by critical reflection back into their theoretical dimensions. In keeping with the pragmatic and constructivist philosophies employed earlier, an objective humanistic perspective is interjected in this chapter by sharing some verbatim qualitative data – comments from the stakeholders. Additionally, albeit it has been implied that professional learning theory fundamentals have not changed drastically over the last few decades, contemporary empirical studies have produced some relevant and interesting findings, that will be pragmatically related to this research. The thesis finishes with contemplations about how these models and findings impact the global project management practice (synthesised in a Vee Diagram), along with their deductive and inductive limitations, and it closes with recommendations for future research.

5.2. Quantitative Deductions
The rationalistic professional online learning concept is statistically significant based on the quasi-experiment results. Now the question becomes how would this statistical evidence apply to the variable relationships shown in the systemic model at the end of Chapter 2 (see Figure 2.9: Professional Learning Goal Experimental Factor Model)? Additionally, how can these results be linked back to the conceptual learning goal theoretical model introduced in Chapter 2 (see Figure 2.8: Synthesized Professional Learning Principles Model)? The first step is to restate, and then make logical sense, of the relevant mathematical and statistical results that were calculated in Chapter 4. Then
the key variable relationships will be used to empirically inform the systemic learning goal model. Later subsections in this chapter will explain how these findings relate to the key andragogical principles underlying the learning goal model, and also how these findings compare to similar empirical tests in the educational psychology literature.

The first category of quantitative metrics that can help to explain the theoretical model are the simple correlation and regressions. The simple correlation shows the direction (positive or negative) and degree of relationship between the professional learning goal method of teaching, and the two outcome variables: GPV score (from the averaged course marks) and Satisfaction level (from the end of course survey question item #19). Secondly, the simple regression calculation will indicate the amount of variation in the two outcome variables (GPV and Satisfaction) explained by the professional learning goal method of teaching. All numbers are rounded off to two positions right of the decimal, and the regression numbers are expressed as percentages (the original numbers are found in Table 4.18: Regression and Correlation of Method with Satisfaction Level and Table 4.19: Regression and Correlation of Method with GPV Score). The simple correlation of method on Satisfaction is +0.67, and on GPV is +0.38. The simple regression of professional teaching/learning method explains 46% of the variation in Satisfaction, and 15% of the variation in GPV score.

These simple correlation and regression values are significant metrics to explain how the professional learning process affects learning performance and satisfaction without considering the details of the other factors such as age, experience, and so on. Each of these metrics will eventually be placed on an upcoming diagram to show the empirical effect on the systemic version of the theoretical professional online learning models.

The next group of figures that can be related to the theoretical model are the Pearson correlation measures, which show each variable may be mathematically related to one another (in a positive or negative manner), without regard to cause and effect (thus we do not know from this statistic necessarily whether Age impacts Satisfaction or vice versa in terms of the flow in the model, but we do know the degree of that impact.)
These figures are shown in Table 4.38 below and they are taken directly from Chapter 4 for ease of referencing and display here (see *Table 4.20: Correlation between Independent Factors & Dependent Variables* and *Table 4.38: Context Stability, Independent Factor & Dependent Variable Correlation*). In this scenario, since these figures do not prove a cause-effect variance relationship. Instead they indicate relative correlation between the independent factors, and between the dependent variables.

There is at least some positive correlation between all the variables shown in Table 4.38. However, only strong correlation (at least ±0.40) will be used to inform the model (these ones are bolded in Table 4.38). This is done because later we use simple and multiple regression calculations to better explain cause-effect on the dependent variables (Satisfaction and GPV), and those process also measure correlation on the outcome variables. Since correlation between Method and GPV as well as Satisfaction is in fact assessed in the simple regression, and since their correlation coefficients are close to these values, the regression statistics are used to build the model (as a cross reference, Method:Satisfaction \( r_1 = +0.68 \sim \text{regression} r_2 = +0.67 \), and Method:GPV \( r_1 = +0.40 \sim \text{regression} r_2 = +0.38 \)). As a result, the following correlation coefficients from Table 4.38 are used to explain the learning goal mode: Age:Experience \( r = +0.97 \), Method:Context \( r = +0.60 \), Satisfaction:Context \( r = +0.55 \), GPV:Context \( r = +0.54 \), and GPV:Satisfaction \( r = +0.56 \). Context could be used to represent the unexplained variation from other factors.

*Table 5.1: Correlation between Professional Learning Goal Variables and Factors*

<table>
<thead>
<tr>
<th>Factor/Variable:</th>
<th>Age</th>
<th>Experience</th>
<th>Method</th>
<th>Satisfaction</th>
<th>GPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience</td>
<td>0.973153548</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TeachingMethod</td>
<td>0.062386267</td>
<td>0.083260643</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>0.179031837</td>
<td></td>
<td>0.131298049</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPV</td>
<td>0.059151265</td>
<td>0.042232212</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context</td>
<td>0.06397198</td>
<td>0.08717558</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The third collection of statistics from Chapter 4 which can be helpful in explaining the model are the multiple regression coefficients of partial determination. These ratios
indicate amount of variation explained between each of the independent factors tested, against the dependent variables Satisfaction and GPV. Note that the learning goal approach is also one of the independent factors tested. Multiple regression statistics are more powerful in explaining the professional learning factor model since all of the known factors were isolated and tested (as compared with simple regressions that only isolated teaching method). Chapter 4 contained two different major sections concerned with this multiple regression testing, with the first section establishing the baseline (and Gender was included as a possible factor but was found to be statistically insignificant), while the second section explored model building scenarios. For the purposes of explaining the theoretical professional online learning models, we are interested in the first section (explained above), to represent the ‘baseline’ professional learning goal cause-effect.

The coefficient of multiple determination for all factors measured against Satisfaction and GPV were 54% and 16%, respectively (see Table 4.21: Multiple Variable Regression and Correlation with Satisfaction and Table 4.24: Multiple Variable Regression and Correlation with GPV in Chapter 4). The correlation coefficients for Satisfaction and GPV were +0.74 and +0.40, respectively (again these were shown in Table 4.21 and Table 4.24). The unexplained cause-effect variation for Satisfaction and GPV when all known factors were used were 46% and 85%, respectively (these were calculated from coefficients of multiple determination in Table 4.21 and Table 4.24). Applied multiple factor regression later increased the explained variance to 66% (Satisfaction) and 44% (GPV), and deductively reduced the unexplained variance to 34% (Satisfaction) and 56% (GPV), respectively, and these latter unexplained cause-effect variation figures will be used to represent ‘other contextual factors” in the professional learning model.

The model building exercise from Chapter 4 will be used to elaborate the cause-effect on the model. Caution is applied in using the model building results because the types of factors created in the model building multiple regression (transformations and transfigurations) are very rationalistic (e.g. logarithmic formulas were applied to some
fields to transform them into new factors). Factors created from mathematical expressions are less accepted by the non-scientific research community to interpret empirical relationships in theoretical models. Therefore I am being very conservative in my interpretation and application of the model building statistics here. Within the model building section of Chapter 4, the best statistical models were the latter two that were able to improve the mathematical model from the simple and multiple regression testing. In Chapter 4 recall that the terms ‘transfigured” and ‘transformed” were used to refer to changing an outcome variable to an input factor, and creating a new factor using mathematical expressions with combinations of the existing input variables, respectively.

In terms of showing how the independent factor combinations systemically explain the variance of GPV performance, Satisfaction was transfigured as an input factor, and overall this model accounted for 44% of the variation in GPV (with a strong positive correlation coefficient of +0.66) – this information was taken from Table 4.31: Transfigured Satisfaction & Transformed Factor Regression on GPV (in Chapter 4). The coefficients of partial determination calculation show the contribution of each factor in the model towards the 44% overall variation on GPV (each figure in the multiple regression is mathematically calculated by holding the other factors constant). The figure we are most interested in for the purposes of informing the professional learning factor model is the sum of “X2, X3, X4, X5” factors which were expression combinations of the Satisfaction factor, which was a 15% combined cause-effect on GPV. Note that these figures are coefficients that contribute to the unit change (variance) in GPV score (as in a linear regression equation) and therefore, mathematically, they can be added together as long as they are treated as a combined effect in the model. This information was taken from Table 4.33: Transformed Multiple Regression Coefficients on GPV (in Chapter 4).

The next statistical result of interest to inform the professional learning goal theoretical model is the transformed factors cause-effect on Satisfaction which accounted for 66% of the variance effect (with a very strong positive coefficient correlation of +0.81). These numbers are taken from Table 4.35: Transfigured & Transformed GPV Factor
Regression on Satisfaction (in Chapter 4). This analysis indicates a very important motivational and self-regulation effect - Satisfaction is strongly impacted by performance in combination with the other factors such as teaching method, age and experience. The unitary cause-effect on Satisfaction by these factors is; GPV = 15%, Age = 16%, and Experience = 13%. This information is taken from Table 4.37: Transformed & Transfigured GPV Coefficients on Satisfaction (in Chapter 4). In the model, the 15% cause-effect of GPV on Satisfaction will be shown but it is felt that adding the Age and Experience combined effect on Satisfaction are best represented by this GPV effect and in the 15% combined effects explained in the previous paragraph. In other words, when coefficients are used to explain cause-effect in a theoretical model such as this, they should be kept together as a linear equation to show combined cause-effect in a model.

The key statistical results discussed in the above section are now added to the professional learning goal systemic model shown in Figure 5.1 (which was originally introduced at the end of Chapter 2). There are some interesting changes to this model from the Chapter 2 version, mainly that some directional cause effect arrows are two-headed, and others have been changed from minor to major effect (and vice-versa). In some cases, certain relationships have been removed from the model since they were either not significant or not tested in the experiment. One significant factor that is shown on the tested model is the ‘Other Factors”, and as described earlier, these represent the combined ‘unexplained cause-effect variance” meaning that they are aggregate unknown impacts. The combined effect correlation between method and context is not shown on the model (r = +0.60) since it does not add any interpretation value beyond the strong correlation already indicated between method and the factors / dependent variables. Unexplained statistical variation (other factors) in the modeling done here is comprised of unknown confounding factors, and experimental error. As discussed in Chapter 4 and above, the confounding element was partially explained by the ‘Context” factor, but the results were not totally reliable. Experimental error is a random element in all human behavior experiments that cannot be totally captured in algebraic formulas (Keppel and Wickens 2004, pp. 134-135, 405, 564); proper control
ensured experimental error was subject-independent and identically distributed within/between treatment groups (see Chapter 3).

![Diagram](image)

**Figure 5.1: Tested Professional Learning Factor Model**

This empirical professional learning factor model indicates that the method has a significant impact on learner satisfaction, and moderate impact on performance. Also Figure 5.1 indicates the reciprocal relationships within the model which might even suggest the performance and satisfaction levels of the students could impact the instructor. An interesting and new cause-effect relationship surfaces between Satisfaction and GPV (they have a tenacious pattern which impact one another), and there is a cumulative effect of age, experience along with teaching method which directly impacts performance and indirectly carries on an effect on Satisfaction level. As such this model informs the mentor, instructor, or even the learner, that the contextual factors, the learning strategies and approaches, do affect performance and satisfaction at a statistically significant level. This allows this model to serve as a practice guideline for professional project manager learning and it will be used by the author for continued
research. Figure 5.1 illustrates that all factors have strong positive correlation and there is an absence of negative correlation in the model.

As Chapter 2 revealed, current empirical and model-building research in educational psychology often focuses on very specific factors related to behaviorism (such as technology impact, course subject matter, etc.). The studies explored in Chapter 2 reveal that few researchers test online learning methods against both humanistic and performance variables. Due to the substantial psychological and motivation-related principles applied in this professional learning goal theory, it is important to test both performance and satisfaction, to measure cognitive and psychological impact.

One very good online learning method study in the literature (and similar to the thesis as discussed in Chapter 2) applied comparable statistical methods to measure the effectiveness of a professional-level virtual learning approach by assessing satisfaction as the outcome variable (Stonebraker and Hazeltine 2004). Although their study was published after this thesis research and experiment concluded, their ideologies and findings towards professional learning are similar to these, such as advocating a learner-centered, anywhere, anytime, teaching approach (p. 210). Also their study actually measured the impact of perceived factors on learning satisfaction levels, not performance. For example, they assessed perceived job relevance, sense of cohesiveness, task interaction opportunity, and social interactions as factors, with overall online course satisfaction as the dependent variable (pp. 216-218). The virtual learning study found similar but less statistical explanation between a learner-centered approach and satisfaction, specifically that 12% overall cause-effect was observed (Stonebraker and Hazeltine 2004, p. 220). This can be compared with the 54% direct and 66% combined cause-effect illustrated in Figure 5.1 for the professional learning goal approach. What is interesting in the professional virtual learning study is that all of the context factors contributed to increased learner satisfaction, specifically 32.3% for level of learning satisfaction, 10.2% for job relevance, and 3.5% as sense of cohesiveness (Stonebraker and Hazeltine 2004, p. 220). As compared to the professional learning goal systemic model tested here, the 12% cause-effect on the professional virtual learner satisfaction described above could in the future be studied as a potential
explanation for the unknown learning context impact acknowledged in this learning goal research.

Another comparative empirical study (more than twice the sample size as this thesis) found statistically significant support for a professional adult-centered online learning design and delivery model that applied many humanistic principles (Roussev and Rousseva 2004). Although their course context design framework was grounded in the traditional Bloom taxonomy (as compared with the andragogical-motivation driven model developed in the thesis) their application of the humanistic principles was comparable to this research and their audience for the courses were also project management-related professionals. Their rigorous paired-treatment experiment contained controls for instructor, course content, and participant differences. They found that the new online "teaching method" was statistically significant (producing better performance: control/traditional group n1=47, new method group n2=65; Fstat=4.92, p<.001, sl=5%; t=3.31, p=.001, sl=5%), using ANOVA and multiple regression techniques (Roussev and Rousseva 2004, pp. 143-146). Their model was able to account for about 20% of the cause/effect variation (adjusted $r^2=0.15$) between the teaching method, learning context design factors and the performance outcome variables (see tables 9-12 in: Roussev and Rousseva 2004, pp. 144-146). Two major statistical differences between their work and this thesis is they increased the accuracy of the participant control by measuring the before and after performance (using the SAT tests); however, they failed to capture any humanistic learner satisfaction variables.

Additional comparable empirical studies illustrate that learner-centered professional online approaches driven by humanistic-constructivist principles are statistically significant (these were explained in Chapter 2: McAlpine 2004; Roussev and Rousseva 2004; Rungtusanatham, Ellram, Sieferd et al. 2004; Moon, Birchall, Williams et al. 2005; Waight and Stewart 2005a; Webb, Gill and Poe 2005; Zhang 2005; Francescatoa, Porcellia, Mebanea et al. 2006). There are many differences between the professional learning approach as compared with the factors and methods used in other studies from the literature so the reader is cautioned in making direct comparisons. Nevertheless, it
could be concluded that these empirical studies mentioned above, and this professional learning research, both produce meaningful guidelines which mentors and instructors could use to design and deliver an effective learner-centered experience to achieve higher stakeholder satisfaction.

5.3. Qualitative Interpretations

At this point we may conclude a statistically significant professional learning model has been tested, which can be considered a quantitative substantiation of its effectiveness, but the question arises: how is the learning approach perceived by the key stakeholders?

Student survey responses, spontaneous emails, and comments from the interviews (listed in upcoming Table 5.2) revealed that the professional learning goal approach was recognized as being different from the normal online teaching method, and all (or at least most) of the principles applied were favorably received. I say “most” because the one theme that was difficult to implement at first was the critical professional peer and self-reflection (required for course marks after the deliverables were produced). Eventually that too became accepted and valued by all students as part of the conceptual and social learning processes.

This qualitative support in favor of the professional learning goal approach is evident from examining the random student comments as listed in Table 5.2. The survey instrument used to capture the course evaluation comments is attached as Appendix 6.

Table 5.2: Comments from Students Confirming Learning Goal Approach Satisfaction

<table>
<thead>
<tr>
<th>Course Evaluation Comments and Random email Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAIL Date: Wed, 17 Nov 2004 18:03:22 –0500</td>
</tr>
</tbody>
</table>
| Ken, To answer your questions, this is currently the only class I’m taking. In general, things are going well. I wish I had more time to commit to this course, but as you know, life has a way of throwing a wrench in the cogs. Work has been busier than usual and I find myself doing a lot of overtime and bringing work home on the weekends. Also, although it was going to happen sooner or later, it happened sooner that my wife and I are pregnant (I’ve known for about a month). I know these are just speed bumps in my learning path, but I’m trying my best to work around them. As for feedback on the course, I think you’re doing a wonderful job of keeping everyone engaged. I can sense that you know exactly when students need a little push to keep them motivated. I like the fact that your feedback is almost instantaneous and always positive. The course is well organized and it seems that everyone is keen to learn more.

Thanks again for the feedback and encouragement, [Student] |
### Course Evaluation Comments and Random email Feedback

**[EMAIL *Date: * Sun, 21 Nov 2004 08:38:34 -0800 (PST)]**

Ken, Here are my assessments from the strategy presentations this week.

*Harley-Davidson*

I let [Peer] pick this case study as I had picked the previous one. [Peer’s] familiarity and interest in the subject area allowed him to go More into detail than I had done in answering the questions for the paper. I combined our work together into the final essay format of the paper and compiled the PPT presentation. Me - I was not as comfortable on this case as it is an area that I am not familiar with. I enjoyed delving into the case and learned a lot about differentiation in the process. I was very interested in Harley-Davidson’s strategy from a US-centric point of view. I formatted the presentation a little differently this time and while I felt that [Peer] and I pulled it off, it could have definitely been better when compared to [Peer 2] and [Peer 3’s] approach. I thought that I did a good job defining the characteristics and strategy of Harley-Davidson but the presentation would have benefitted from a formal SWOT analysis. [...] This has been the most interesting approach to study thus far in the [university] program for me. I find that I learn a great deal from the Case studies but even more in the course of the presentations. It is educational to see the differing approaches and I think it says a lot About us, as a group, that we come up with and share ideas during the presentations which enhance our overall knowledge.

Thanks, [Student]

**[EMAIL *Date: * Thu, 24 Feb 2004 09:38:28 -0500 (EST)]**

Professor, It is with a sense of great satisfaction that I send to you this final PEF. I can only rate our work as I have previously sent to you my evaluation of [Peer1] and [Peer 2’s] project. From my end, knowing the hard work and time [Peer 3] and I put in for this final project covering the entire course material, I can suggest no less than a score of 5. I hope that our presentation and our final paper can justify to you our comprehension of the course material.

Thank you very much for your time and attention throughout this course and I hope to have you as a teacher in future courses. [Student]

**[EMAIL *Date: * Thu, 24 Feb 2004 16:19:14 ±0500]**

Ken, I wanted to thank you for a fantastic course. I took [course] in university, but I didn’t retain near as much as I did this time around. This final project was really a culmination of everything we learned throughout the course. I think we did a good job on this project, although we could have always done more. The challenge when working in a group is appealing to every group member’s needs. However, I’m proud that we were able to budget our time really well on this one. The EA project was very time consuming, but we made deadlines and stuck to them. It helps when you’re both very passionate about the project too.

[COURSE EVALUATION SURVEY COMMENT]

This has been the most engaging course of the program for me. The instructor maintained course flow without undue pressure, achieving significant student interaction in the process. Although I am not in what may be deemed a traditional marketing occupation, I found that much of the material was relevant and served to expand my knowledge, making me more effective in my workplace. The format and weightings, in my view, are where they should be. I found the interaction in the discussion forum to be particularly advantageous. I tried to shy away from answering the same questions as the other students as I found this aspect repetitive. I thought the opportunities to take the concepts, apply them to our own experience, and share them with the class were more practical. The real life examples help to solidify my understanding of the concepts and I was able to relate these concepts better in the workplace. The university technical and administrative support was outstanding. I think that it would be useful to examine ways of enhancing the on-line learning experience in VClasses. [...] The past two years have been illuminating for me and I have thoroughly enjoyed this learning experience.

[COURSE EVALUATION SURVEY COMMENT]

A- Course Content : I learned major marketing concepts and theory that justified many transactions that I have seen in real corporate life.

B- Deliverable format : Good format as any other course I had with [University]

C- Instructional assessment: The professor was so supportive and offered his experience to teach the course contents and even beyond...my personal rating of the Instructor: Excellent.

D- University Technical services: Good overall , but would like to have some flexibility to add large files and videos on the V-class platform. Thank You.
Course Evaluation Comments and Random email Feedback

[COURSE EVALUATION SURVEY COMMENT]
The course content was very relevant and the groups cases showed that, the class was delivered very well and there texts and used of the v class was the best I had ever had. The professor incorporated the text and v class material in a very informative and detailed manner which made the education process very enjoyable and understandable. Overall the best class I have had to date on all levels from teaching to text to v classes.

[COURSE EVALUATION SURVEY COMMENT]
a) Course content is MBA material indeed. [Course] concepts are not hard to understand. However, the course organizes and categorizes this knowledge to give the future manager the ability to understand a current marketing situation and improve it using several analysis tools.
b) I think there should be more weight for the individual case study and less for the peer evaluation part. I enjoyed the structure of the deliverables in the discussion area. They encourage application of theory, quick research and exchange of ideas and personal experiences. However, the I found them too long and not many student were able to finish them all,
c) I like the instructor’s macro management style. Students are inspired not pushed to participate. The instructor always gave his general and one-on-one feedback which helped students know if they were on the right track or not. I enjoyed the individual and group case studies, which were direct applications of the marketing concepts. [...] 
d) Super. [referring to technical services at university]

[COURSE EVALUATION SURVEY COMMENT]
Overall I really enjoyed the course. It is very relevant to the business world and I feel I could apply some of the principals in my current job. The course was very well organized, the text was excellent and the vclasses aided in my understanding of the materials. The deliverables were excellent and they reinforced the theory from the text and ebook. Ken you marking system is very analytical and well laid out. I feel you have done one of the best jobs of all instructors I have had in this program at providing relevant feedback on deliverables and marking them fairly. Personally I feel the take home exam should have been worth more value. My main critisims was the discussion board. Forcing students to participate in the discussion board is an excellent idea, but I felt that once a week was too much. The quality of the posting faded over time and it was almost imposible for you Ken to provide the needed feedback on each and every posting which I feel is necessary.

[COURSE EVALUATION SURVEY COMMENT]
A) The content of the course is excellent. The theory is very practical and applicable to the day to day business context. The cases and examples to support the theory are very currrent with the realities of the market. 
B) The deliverable and weightings are fine. There is a good balance between individual and group work. 
C) The instructional approach is great. Lots of feedback and guidance. Very personalized and motivational. 
D) [University] administrative services are very good. A suggestion would be for [University] to limit the number of courses taken by full time employees to two per session. I find that some individuals are not fully participating in group work due to limited availability and time pressure given their enrolment is several courses and their full time work commitments. This impacts and reduces the benefits of group learnings.

[COURSE EVALUATION SURVEY COMMENT]
The only comment is thank you to Ken this was a well designed course, I just wish I was able to participate a little more.

These comments emanate directly from the professional students taking the two courses within the quasi-experiments (where professional learning goal theory was applied) and they are similar to positive student feedback received from the pre-thesis international project management pilots (reported in: Strang 2004a). The reader should note that the comments in Table 5.2 were left verbatim (except for the removal of confidential
information) and as such there are spelling and grammar errors. Nevertheless, these and other comments were very supportive of the approach. The qualitative findings from Table 5.2 (along with many other comments and fields from the course surveys) will be analyzed and shared in future research using factorial analysis of learning goal performance coded by theoretical attribute.

In this research, at a more detailed level, some of the techniques utilized within the professional online learning approach involved establishing clear links between learning objectives, assessments, and the personalized learning goals. Also the use of reflective peer and self assessments (not journals) after each deliverable forced the students to reveal the dynamics of their group work, what they perceived their peers did in terms of explaining theory using work experiences, as well as problem-based social development and cognitive learning. Also the self-reflections forced the students to think about why they are learning, what they would do better next time, and what they could do with the theory beyond the course context (such as projecting the principles into their work situation). The cooperative small group work consisted of asynchronous online dialogues that allowed students to verbalize-through-writing and narratively-interact with peers to ‘work out’ their cognitive understanding of the principles. Students appreciated novel techniques to stimulate interest such as challenging games borrowed from the Four Door (Thiagarajan and Thiagarajan 2003) concept discussed in Chapter 2, and a unique motivational prototype was also developed to simulate the ‘real world business environment’. The students also stated they appreciated the reduction in formal tests and examinations (most of the work consisted of research papers, presentations, and critical reflection, with a final exam valued at 15% of the total course weighting, with full permission of the university).

Self-regulation and self-efficacy were promoted by allowing flexibility in the deliverable approaches, factoring student needs into the assessment weightings and methods, and allowing the students themselves to officially assess their peers using a ‘Peer Evaluation Guideline Factor’ developed specifically for the professional learning goal approach.
Figure 5.2 was created from the results in Chapter 4. The chart is a cumulative frequency polygon that empirically illustrates that satisfaction levels are higher when the professional learning goal approach was applied. This chart is directly fed by the source data, showing the results from the end-of-course survey question item# 19 that asked students how satisfied they were overall with the course.

![Figure 5.2: Course Satisfaction by Method - Cumulative Frequency Area Polygon](image)

The x-axis represents the six survey response scale levels (0 to 5) while the y-axis indicates the survey response frequency counts. Obviously it is desirable to have all ‘strongly Agree (5)’ results from students in a course you are teaching or facilitating. The fact that pre-treatment levels were no lower than ‘Neutral (3)’ indicates the real challenge in this being that no student was unsatisfied with the status quo method… but they were more satisfied overall with their learning context when the professional online learning approach was used.

5.3.1. Statistical Anomalies in Dialectical Constructivism

Occasionally the best-laid plans don’t work as intended, which is the case with some aspects in the application of professional online learning theory in these quasi-experiments. In this subsection, several phenomenological observations are explored from a dialectical constructivist standpoint. This latter term is borrowed from ‘constructed synthesis’ as defined by (Moshman 1982, p. 375), that posits ‘thought’ and ‘experience’ are inextricably intertwined with the learning context, and therefore the...
best way to uncover these statistical anomalies is for me to be emerged within the environment to experience it, and to critically reflect on its rationalistic meaning.

The principles of complex humanistic motivation, social learning, and constructivist critical reflection were applied to all students. As the statistical evidence from Chapter 4 shows, the satisfaction levels were much higher with this approach as compared with the status quo method (which remained the case even when the author applied both styles as a control measure). However, I must confess it was hoped that the experiments would result in much higher GPV outcome, yet this was not the case, albeit slightly higher scores were observed. This slight departure from hypothesis could be explained by reverting back to the very psychological principles that inform this research. Satisfaction is an affective dimension which could change much quicker than complex cognitive understanding, thus this might explain the lag in performance scores rising (as they did but more gradually).

Also, satisfaction is a phenomenological condition which does not require actual learning, whereas the completion of assignments, virtual dialogues, synchronous presentations, exams, and critical self & peer reflection require complex cognitive and socially developed skills, that do imply mastery (performance) learning. Again this is why it was so important to measure both satisfaction and performance in the experiments. Higher order learning is itself aided by meta-cognition and this takes time to develop. The professional learning goal approach is different than the lassize-faire method to the extent that students have in fact commented on this, not that they do not like it, just that “it takes awhile to believe this and [that] I am really learning more out of this” (email from student pseudo-named Ihab, 2004), as one student put it. Thus it is anticipated that replications of this methodology with the same students will result in a higher GPV trend on average. Replications of this method with new students should produce similar results.

This brings up a more fundamental social science-statistical inference issue, which is that there is a very real possibility that there is an auto-regressive casual relationship between the learning goal method and GPV score, whereby the outcome variable lags
the independent factor manipulations. This presents as a delayed increase in cognitive and social performance after a controlled treatment is applied. The delay could be weeks, or even semesters. It depends on the individual learner’s personality and the contextual factors (teaching method, previous experience, family, work, instructor, content, university, etc.). Thus in future studies it may be wise to apply a time series trend algorithm to interpret this empirical cause-effect. Ironically this analysis clue came from my work at Blue Cross whereupon we applied a nonlinear forecasting algorithm to predict morbidity and mortality claims (health and life insurance), which utilized key macro-environmental variables along with group factors, in a time-lagged fashion, to predict future trends for underwriting classification. This is the kind of systems thinking underlying information data mining methodologies.

This also makes sense mathematically since the equations I used in my statistical analysis were linear (least-squares as explained in Chapter 3) which actually compares adjacent means and standard deviations for variances, but my recommendation I refer to here for future studies is to make non-adjacent, non-linear comparisons. Sometimes identifying another independent contextual factor (as I did at the end of Chapter 4) will capture the auto-regressive effect (especially if it is quadratic or exponential such as the transformed factors I used in Chapter 4), but such a variable will not be as precise as lets say a second order lag indicator. I intend to investigate this in future research.

However, the above explanation may account for 47 of the 48 samples so there remains one observable incongruity. The sample distribution fluctuation of interest is the situation with one student (pseudo-named Amy) who performed well on three of the four courses, but ironically, the one course she achieved a slightly lower GPV score on was the one where I applied the professional learning goal approach. Further adding to the irony was that her satisfaction levels were reported as consistently high on all four courses (including the one where she obtained the lower GPV grade). Also note this was the only obvious anomaly discovered in the sample data (n=48). Chapter 4 explored this lower performance under learning goals approach phenomenon to arrive at a logical explanation. The student had just purchased a house (actually she was in the process of negotiating and closing the deal during most of the course). As per her own words:
I am really excited about getting my own place since I have been living in rentals for too long even though I’ve been working six years now…so I guess yeah it’s time to take the big step. OK I know this impacted my [course] because I just wasn’t able to contribute to the online discussions and your vclasses the way I wanted to ... with my working and running around dealing with real estate agents and the lawyers (paraphrased interview with student pseudo-named Amy, 2004).

It would be convenient to remove this particular datum from the 48 samples but of course that would not be ethical. Additionally, the overarching goal for this thesis was to find a learning approach that would work for busy professionals, with realistic contextual crises (if available), and this incident does nicely mirror reality. Thus the model must include variables and principles to address the unexpected learning interruptions of busy project managers, whether the cause be work and/or personal, the fact is, with busy project managers, things happen.

Thus this emphasized the necessity of actually including and measuring a contextual factor within the professional learning goal approach model, otherwise it will always be impossible to accurately and statistically measure its true effectiveness. Additionally, as discussed beforehand, this variable may need to be auto-regressive (time lagged). In fact probably several additional factors are needed to perfect the model to explain more than 66% of the cause-effect between the independent factors and the outcome variables.

5.4. Theoretical Sense-Making

In this subsection, the focus is on answering the question of how does this compare to similar contemporary analysis in the research community? To actualize this, the link between theory and practice is discussed, in terms of connecting the most relevant professional learning principles from Chapter 2 to the results reported in Chapter 4. Several key theories are particularly relevant to discuss here, namely, the learning model drivers of andragogical motivation, self-regulation, and self-efficacy. Additionally, the cognitive and social developmental self-schema principles are also
important to reflect upon here. Over and above these key factors, the general instructional approach is also discussed.

5.4.1. Applied Professional Learning Models

Chapter 2 developed four critical models that were applied in the course experiment (as elaborated in Chapter 3). The important models that were applied from Chapter 2 are:

1. Figure 2.4: Systemic Model of Self-Regulation, Self-Efficacy, Goal-Setting - showing the interaction of the key learning principles underlying this new approach;
2. Figure 2.6: Professional Learning Instruction Process Design Systemic Model – the ‘new learning method’ this author used in the paired treatment courses;
3. Figure 2.7: Professional Learning Context Design Systemic Model – a blueprint to guide the online learning context configuration, content, flow, assessment, etc.
4. Figure 2.8: Synthesized Professional Learning Principles Model – a guideline constituting a synopsis of all the ‘applied’ professional learning principles.

The models were applied to all course designs, but as noted above, it was only the author who applied the professional learning instructional approach (as explained in Chapter 3 and denoted by the ‘LearningGoal’ as the ‘new method’ in Chapter 4 and here). The fundamental principles applied to design the professional online learning are:

1) Create content and objectives illustrating why the theory is important to learn;
2) Coach professionals through the process of meta-learning and peer/self-reflection;
3) Challenge learners to relate the topics to their work/life experiences, using examples;
4) Build learner self-confidence with respectful peer and instructor formative feedback;
5) Provide reminders and guidelines as busy schedules make people forgetful;
6) Explain ‘why’ theory, assessments, and critical-reflections, promote learning;
7) Encourage people to be ready and self-motivated to learn, ask for their commitment;
8) Learners need help to establish positive beliefs, overcome inhibitions, and improve behaviors, guided by periodic constructive feedback from mentors and instructors.
5.4.2. Applied Motivation to Increase Learning

The professional learning approach uses andragogy principles to motivate project managers to continue their education, to cognitively learn subject matter, and perform critical thinking to conceptually learn. This approach also helps project managers to maintain their volition for completing continuing education courses since they will build their self-confidence throughout, see the possible application of theory for their own work contexts and/or personal lives, and feel very satisfied with their learning.

This approach applied the theory from Chapter 2, being that learning motivation is driven by expectancy that people believe they can achieve, and that there are desirable benefits in achieving. Many higher educational studies have found this to be true, in particular that although values are subjective in nature, the quality of instruction can significantly impact the self-efficacy that an individual feels toward the likelihood of their success (Wigfield and Eccles 2000). Creating interest in a particular educational topic or activity increased intrinsic motivation, by encouraging online peer dialogues that reference the contemporary social context, and by explaining the purpose of the topic for skill building. Personal interest (trait like behavior, more stable over time), and situational interest (short term, invoked by something unusual in the learning environment), have both been shown to positively affect learning especially if they evoke feelings of pleasure, excitement, and liking in association with the subject matter or discussions (Schiefele 1998).

The major goal for increasing interest motivation is to promote more effective cognitive processing, schemata development (memory retention) and conceptual understanding, which was observed in the experiments by higher GPV outcomes. While it is possible other factors can increase motivation and learning affect, studies have shown higher educational achievement from situational interest motivation (Andre and Windschitl 2003), and especially conceptual understanding (including correcting faulty personal theories), through personal interest motivation in the learning context (Linnenbrink and Pintrich 2003).
However, while it is easier for an instructor to create situational interest motivation in a topic by making it sound exciting, etc., studies have shown that it is personal identification and interest in a topic which promotes higher conceptual understanding, higher academic achievement (Palmer 2004), and thus more learning satisfaction (McDaniel, Waddill, Finstad and Bourg 2000). The approach used in the experiments here achieved higher level motivational interest in a very flexible manner by allowing students to choose work or community problems to research and dialogue (related to the subject matter of course), or a case study representing a domain that they had career ambitions in, using either small group or individual formats. Thus this method applied andragogical motivation by providing personal interest, self-choice, and it also catered to the individual learning styles. Recent literature advocates that instructors need to appeal to multiple learning styles (to think beyond visual, auditory, and kinaesthetic teaching methods and consider how the information is organized), when using online synchronous and asynchronous delivery techniques, which was found to improve learning (Barbazette 2004).

5.4.3. Applied Learning Goal Setting

Requiring the students to set and articulate their goals was very effective to help them ‘figure out’ their personal interest motivation, set their expectancy values, and map out achievable objectives to aim for. As such this ties together motivation and self-regulation, since the goals (when they are documented) serve as milestones to measure learning progress, confirm understanding, and to a great extent sustain motivation (Locke and Latham 1990). Studies show that when goals are set, learners know what they want to accomplish so when they read, write, dialogue, and present, they direct their learning strategies and cognitive engagement thoughts accordingly, while continually monitoring their progress towards those goals (Brickman, Miller and Roedel 1997; Locke and Latham 2002). As Chapter 2 advocated, learners must be ready to learn by doing the above activities. Recent studies confirm the relationship between readiness for learning and organizational effectiveness (Min-Huei Chien 2004), and although that study explored the organizational level versus professional learning effectiveness, it supports this research in that the role of the mentor or instructor is to help students become ready.
In the experiments the students would sometimes express their frustrations, busy schedules, subject matter difficulty, and other factors that either helped or hindered their learning. In cases where contextual factors negatively impacted learning progress, the goals were used to reactive the learners motivation…since after all, these goals were originally viewed by the students as being important and achievable, so unless one of these factors had changed (expectancy or value), usually by reminding the learner of these would succeed in helping the learner. In those cases where value or expectancy had changed, then the goals needed to be modified to match the new beliefs. Thus it is easy to see how articulating learning goals, and assessing them during courses, can serve multiple purposes, benefiting the learner and instructor/mentor. In several cases learners experienced this, and although they were a bit reluctant to go through the exercise, after completing it, they commented that the process helped them to both understand and change, as well I believe the exercise of recognizing and acting on learning problems serves as a sort of psychological frustration-letting catharsis.

The authenticity and quality of goals was also important, and this became obvious when students set too low or too high (or superficial, unmotivated) learning objectives. The most successful approach was to encourage mastery goal setting, by suggesting students use a visioning strategy of picturing themselves knowing theory, applying principles, and being sought after for corporate advice. Research indicates people are more likely to create effective mastery goals in subjects they take interest in, identify with and have high self-efficacy towards accomplishing (Murphy and Alexander 2000).

The approach I used was to recommend higher level goals, followed by more specific objectives related to the subject matter and assignment deliverables. Mastery goals were meant to focus on process competency, conceptual understanding, and knowledge sharing, whereas performance or avoidance goals were discouraged since they tended to create team friction and tangible outcome orientation. Other research confirms that self-focused performance goal setting in education tended to result in peer competition, achievement outcomes, but mastery goal setting focused on tasks and processes resulted in better conceptual learning (Elliot and McGregor 2000).
In the professional environment, teamwork is often more important than individual accomplishment, as such I encouraged the students to focus on process and peer interaction as they described their goals. Research suggests that this ideology of conceptual learning mastery in lieu of personal cognitive development is more effective in most learning contexts (Maehr and Kaplan 2000). Most professional learners state they want to pass the course assignments...but not always. An interesting example of this (where learning goals may outweigh course performance) occurred in the quasi-experiment. One professional learner specifically stated he wanted to learn the subject matter at hand but only to a certain practical extent, and he even gave up writing a paper without properly finishing it stating they had gone as far as they wanted to in his learning, and with respect to the other demands on their time, he was not able to go further with it. Interestingly enough, the student wrote a great paper (as he was very motivated and interested in exploring the topic), but he supplied no references, and no conclusion, yet despite this was still able to achieve a passing mark on it based on the assessment grid.

There can be a negative side to goals if the student does not honestly articulate them (because they may be competitive, or purely performance directed). Although this did not seem evident in the student articulated goals within these courses, it did occur in an earlier pilot course as one student was very concerned with producing a good paper, and it seemed to this author in reflection at the time that performance goals were higher than the learning goals. At the time it did prompt me to send a persuasive email encouraging the student to consider it there was any interest on the part of the student to dialogue with peers to critically explore the subject matter for interesting and alternative perceptions. Instead the student preferred to maintain the performance-oriented goal. In the end this became a self-goal for that person, and they became alienated from their partner (it was a small group project), and therefore the partner commented on this in their self-reflection that they felt "this lack of team participation impacted the mark". I did not realize the implications at that time, but now in applying the professional learning goal approach, I would try to have that person focus more on setting mastery goals to apply theory in work (group) situations. Several studies point out this problem...
of emphasis on self-goals and/or failure (avoidance) goals is occurring in educational settings and this shows up as lower quality group work (Dowson and McInerney 2001). In retrospect, I have found that by having the learning goals written and verbally explained by the student, it often improves their self-honesty and commitment towards long-term learning.

Furthermore, encouraging students to create realistic strategies aligned with their learning styles and personality dispositions was also very helpful, such as providing flexibility with assignments and deliverables. Instead of requiring specifically a paper, presentation, participation in online dialogues, or participation in an online game simulation, students were able to apply some mix-and-match freedom, within certain boundaries to maintain university course practice and assessment standards. Some studies have taken this a step further to show that applying chaos and gaming theory to experiential learning improves the instructional approach (Leigh and Spindler 2004). In my professional learning goal research, using different modes such as simulations appeased the different styles professionals use to cognitively and conceptually learn. For example, people with open-minded critical thinking styles show more advanced reasoning capabilities and are also likely to achieve conceptual changes when given diverse learning perspectives to evaluate (Sinatra and Southerland 2004), while cognitive knowledge oriented individuals learn more from reading online or paper based materials and base their learning on logical empirical reasoning (Cacioppo, Petty and Feinstein 1996; Dai 2002). Research has also found that mentors can model productive dispositions for students to promote critical thinking, which includes questioning the relevancy of principles in social contexts and displaying open-minded diverse perspectives (Kuhn 2001). Of course, other factors will be at play here, but certainly in these thesis experiments, appreciation of the individuals learning style for goal setting was best accomplished through flexibility and student decision making (rather than applying formal instructional requirements).

Another potential drawback to mastery learning goal setting was that there were in some cases too many goals, or the student’s goals overlapped or one became incompatible with another goal, which by definition would result in one being worked on less, and
possibly resulting in lower effort and lessor satisfaction. One example of this in the experiment was the goal overlap between a research paper and its follow up online presentation, whereby both included similar goals, and each contained objectives that could negatively impact one another, as with one student wanting to use an interview clip in a presentation, which could not be brought into the paper, and which would steer the direction towards another applied theory as opposed to the main objective of the assignment being to give examples of a specific theory from the project context. The solution to this mastery goal conflict problem seemed to be as simple as pointing it out to the student who subsequently revised the goals to make sure that the video referenced also had a written case study which could be used to provide better theoretical examples for the paper. A number of researchers also report that a goal integration solution worked by applying mastery goal co-ordination to prioritize objectives (Covington and Müieller 2001). Another effective variation to this in the literature was for mentors to structure and/or encourage students to design multi-purpose goals (such as overlapping projects, applying topics across courses) that will result in simultaneous accomplishment (Wentzel and Wigfield 1998). Based on experience I feel this advice is applicable to busy project managers.

### 5.4.4. Applied Self-Regulation

The theoretical relationship between goal setting and self-regulation is evident from the above discussions and from the theory building in Chapter 2. The theoretical aspect of self-regulation was applied to the learning goal approach by encouraging students to: select tasks and objectives aligned with their personal interests, minimize unrelated work (drop unsupportive goals), suggest their own assignment relative weightings (consequences), and internalize the importance of the learning goal. The first item, aligning tasks/objectives with personal interest, was explained above. Educational studies found support for this as students will select goals of longer term interest when given choices and encouragement to do so (Covington 2000). Although that study was with high school students, this should be generalizable at the professional learning level.

An approach which also helped professionals self-regulate their learning was to supply them with research templates, paper writing checklists, and tips for creating/giving
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effective presentations. These materials inform the student about the content requirement expectations, the required phases and sequences for producing learning deliverables, and the level of quality for papers and presentations. The student is then able to create high level project plans to help them regulate the learning deliverable process. Additional guidelines were provided to help students rate their own progress (self-evaluations), and these were mapped to the course outlines and deliverable assessment grids. This informed the students which elements were important in terms of course evaluation so they could budget their time effectively. Studies (at the high school level) have proven that such instructional guidance has resulted in better student self-regulation (Spaulding 1992) and higher feelings of unconstrained learning (Reeve, Bolt and Cai 1999). The technique of providing assistance and assessment clues was extremely effective as it not only helped students self-regulate, it also helped them achieve focused mastery learning, and thus seemed to increase their self-confidence as the course progressed. This approach of proving checklists and other supportive mechanisms has been effective in helping school students deterministically regulate their learning (McCaskin and Good 1996). There is not a great amount of empirical findings on how this helps adult learners but the principles are logical and noticeably beneficial for the students in these experiments.

Self-regulation has both a cognitive and physical aspect, in particular the latter, the environment must also be monitored and controlled by the professional. This will normally involve choosing appropriate times and places to study, assuming as I did in these course experiments (which were completely online), that the work could be done anywhere, even the real-time presentations (as long as Internet access was available). This finding of self-regulating the learning context by minimizing distractions and choosing good times/places to study is well documented in literature as being effective for all levels of learning (Wolters and Rosenthal 2000; Locke and Latham 2002). In the professional learning approach, acknowledgments are given just to make everyone aware of the fact that learning is a student responsibility which takes determination and costs them money. Acknowledging the monetary attribute of education (the price they pay for courses) also provides a socioeconomic level of recognition to the importance of continuous learning.

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Professionals using this model also have the ability to suggest their own assignment relative weightings, such as whether an exam, paper, presentation, etc., is worth 15% or 20% (or another amount within prescribed limits), overall in terms of course assessment. Of course as explained earlier the boundaries of these changes are predetermined in the course plan but with this approach the professionals are given the freedom to make some choices, and in some cases negotiate with a partner or group on the weighting subscales (such as what the value of a paper versus presentation of it should be within a prescribed limit, assuming the total combined weighting towards the course itself remains unchanged). It has been my experience that it does not need to be a significant choice, but by designing-in the flexibility in the course plan seems to strongly affect motivation and self-regulation.

Additionally, as mentioned in the applied motivation discussion above, professionals also can make decisions regarding their learning strategies and styles, such as whether a paper will be individual or group (again within prescribed limits). In some courses there are certain expectations and standards requiring a minimal level of weighting or format (e.g. for one course in organizational behavior it is mandated that at least 15% of the course work will be group-based activities such as a paper, presentation, and/or online dialogue discussions). Promoting self-regulation by allowing students to impose their own outcome consequences was found to be effective in other studies (Wolters and Rosenthal 2000).

Another self-regulation motivational approach applied in the experiment was not giving the answers for exams or quizzes but just providing the incorrect questions back to the student for them to research the answer (the e-syllabi guaranteed instructors would provide constructive feedback on student’s deliverables within a specified time period but it did not include a requirement for providing the correct answers to quiz, assignment, or exam questions). This approach motivated the student to continue to learn (to determine the answer), and if the right answers were provided, in many cases, a few additional points could be obtained as part of the self-reflection (determining what went wrong with the theory application and what could be done to improve the
learning). This worked well and students responded positively to it. Self-reflection is a critical element underlying the motivation and self-efficacy principles discussed in Chapter 2, and these have been successfully applied in other research, such as one study applying *Mezirow’s theory of reflection* (Mezirow 1991) to improve learning by encouraging professionals to better understand what their peers mean to gain multiple knowledge views (Sherlock and Nathan 2004).

Internalizing learning motivation refers to a form of self-regulation by goal-setting, self-monitoring, and adjusting learning, to gradually adapt behaviors over time. The normal context for professional self-regulation is a supportive learning environment, some autonomy in selecting work and formats, as well as some level of structure imposed around the whole activity to maintain high quality educational standards. According to theory, when professionals internalize self-regulation, they first become extrinsically motivated (ie. attraction of a new certification from completing a course), then they introject by applying the learning activity (without fully understanding it), next they identify with the potential value of the learning activity, and finally they integrate the behavior into their overall values and learning processes (Deci and Ryan 1995; Deci, Koestner and Ryan 2001). I can’t say students were this systematic in their self-regulation, but their behavior did improve and become more self-regulated during the courses. I would anticipate this to continue in their future courses.

Help seeking was discussed in Chapter 2 as a self-regulation method students can use to obtain assistance from instructors, mentors, and peers, when they are having difficulty understanding particular subjects. This was encouraged as part of the professional learning goal approach, and by emphasizing this at the instructor level as part of transformational leadership, it was believed that this motivated the students to feel it is normal to ask for peer advice during the self-monitoring and social cognitive development process. It was also believed that if this was not emphasized during the courses, then fewer students would ask for peer or mentor assistance, and likely it would be those with open-minded propensities, higher-achievers, students that were probably
already doing quite well as a result of their collaborative approach. Independent studies corroborate this finding that help-seeking can improve learning, self-efficacy (Skaalvik and Valas 2001), and those students whom are struggling often ignore opportunities to ask for peer and instructor help (Zimmerman and Risemberg 1997; Turner, Husman and Schallert 2002). Thus research suggests the instructor should initiate the principle of help seeking to the students by sanctioning it as an ‘ok process’ for advanced professional learning.

5.4.5. Applied Learning Self-Efficacy

Chapter 2 advocated that a critical driver for professional learning is self-efficacy development (confidence in specific skills and knowledge). This was enhanced with the learning goal method by providing instructor, peer, and self-feedback. Part of the requirement was to learn how to learn and critically reflect on self and peer work. As the saying goes, self-confidence feeds self-confidence. Research shows the students will achieve higher quality learning outcomes by building self-efficacy. Studies have accentuated the importance of feedback, as noted that "of all the facets of good teaching that are important to them, feedback on assessed work is perhaps the most commonly mentioned" (Ramsden 1991, p. 99). As seen from the student comments above, giving helpful feedback on students’ work is an essential commitment in any teaching-learning situation as it is clearly related to teachers’ accessibility to students. Students see effective feedback as being critical for them. Of course such results are based on a meaningful understanding of the focus of the learning. In this instance, with the focus being on professional learning, the theory implies that students who used critical self and peer reflection approaches developed greater understandings and more detailed perceptions of the course subject matter. This also relates back to the complex cognitive development aspect of learning discussed in Chapter 2, in that these students constructed declarative, procedural and conditional knowledge. In these circumstances, their perceptions about their own competence increased (as indicated by their performances during online presentations, post-presentation question & answer sessions, and the email comments).

14 Introjection in this context means to incorporate the characteristics of [another] person or object into one’s own psyche [traits] unconsciously Houghton-Mifflin (1994).
As noted in Chapter 2, self-efficacy beliefs depend to a large extent on an individual’s perception of the task and the personal requirements necessary for its successful performance. Evidence reviewed from the research literature suggests that students who use different approaches to learning conceptualise the learning environment differently (Weinstein 1991). Some of the qualitative findings here suggest that professionals who vary their use of approaches to learning (apply meta-cognition), and similarly form different conceptions of the theory-to-practice environment. Thus, those students who freely engaged in self-reflection approaches for professional learning may have formed fundamentally different conceptions of the underlying theories and how they would be applied in work scenarios.

Another theoretical aspect of the quasi-experiment findings was the professional learning approach affect on students’ perceptions of their competence in performing the tasks required to write papers, conduct research, work in small groups, give online presentations, and document their critical reflections. Specifically what I was looking for (and found) is evidence of their perceptions and how that impacted their own learning and behaviour, despite other influences. The strengthening of self-efficacy was first evident in the increase in satisfaction, and secondly (a lag result), the increase in GPV score. This is likely a result of improved quality learning produced by greater reliance on critical reflection and self-efficacy development (Ramsden 1991). Additionally, I expect self-efficacy to now remain relatively stable across future courses for these students, hopefully with other instructors as well, which is a recognized finding supported by independent research (Bouffard-Bouchard, Parent and Larivee 1991; Goddard, Hoy and Hoy 2000). It is not surprising that cognitively complex involvement in professional learning and progressive mastery of subject matter would be associated with stronger growth in self-efficacy, since this pattern of development is consistent with Bandura’s view that mastery experience provides the strongest influence for developing self-efficacy (Bandura 1977b; Zimmerman, Bandura and Martinez-Pons 1992). This also makes logical sense that the more we know something the more confident we are about applying it in practice.
There were some instances where I had to rely more heavily on techniques of verbal persuasion and modelling to assist professional learners to develop self-efficacy, which was done by applying transformational and charismatic leadership via individual emails, telephone conversations, and private ‘break-out room’ conversations in the online virtual classroom. The result of this was a definite increase in learner self-efficacy. For example, in one situation, I applied encouragement and consideration to a student schedule to make a paper presentation in the virtual class later that day. He ‘dropped a few hints’ that he was a bit unfamiliar with how the technology worked, and also about how the question-and-answer process would work after his presentation. Since this was his second time doing this (and his first attempt in another course did not go well he told me), we chatted together about the flow of his presentation and I gave him a ‘conceptual picture’ how a question-and-answer session usually goes. Right before the presentation he panicked because he didn’t believe his microphone would work right (he sent me a private chat message). At that point, while another student was giving her presentation, I electronically moved him and myself into another virtual class, and we practiced for probably about two minutes. At that point he stated ‘thanks for your help, this did help me’...he even seemed a bit embarrassed at having to ask for help since I think he felt everything was going to be ‘ok’ (I perceived this from his being anxious to move back to the main virtual classroom). He gave a terrific online presentation and another student specifically made positive comments on it...which suggested to me that the student had also talked to his peers as a help-seeking manoeuvre as well. I should point that I have done this a few times (applied both transformational and charismatic leadership) using the online classroom technology because the sessions are taped and are thus available for me to review afterwards to assist in marking and to view anything I may have missed.

5.4.6. Applied Learning Contextual Design

In developing the professional learning models I did not focus on technology (but I did leverage it), which is a result of my valuing the principles of learner-centered methodologies over other stakeholder viewpoints in this research. Here I discuss certain relevant aspects of the instructional design and delivery principles outlined in the latter
part of Chapter 2. I explain how I have adapted these methodologies to apply andragogical motivational theories, along with the principles of self-regulation and self-efficacy development. These professional learning goal approaches are not activities or requirements listed in course guides or e-syllabi – they are the principles articulated in Chapter 2, contingently applied by the instructor to improve the learning context, the learner motivation, confidence, and self-regulation to achieve learning goals.

As busy project manager and continuous learner myself, I feel that a major benefit of online professional learning is the anywhere, anytime flexibility, as well as its capacity to reduce the isolation of distance learners from one another through virtual dialogues. Many studies describing computer mediated learning support in university settings have focused on particular learning activities and functions that enable students to communicate and share ideas, but the paradigm of andragogical and constructivist professional learning developed here instead focuses on real learning and satisfaction.

Intentional learning theory advocates learning as a deliberate activity, and research confirms success by emphasizing that students need to be engaged in self-monitoring, self-regulation and goal directed learning (Choi and Hannafin 1995). This has also been successful in several universities for promoting a process-based model of learning (Jarvela 1995). This was achieved principally in this learning goal approach through case-based scenarios and flexible syllabi that maximized learning outcomes such as higher order learning, self-regulation, self-management, and self-efficacy development. Current research advocates this importance of applying andragogy and social learning principles as a strategic method to improve the professional learning environment (Kessels and Poell 2004).

The social development learning theories discussed in Chapter 2 that emphasize the role of the learner and peers in the learning process are increasingly recognized as relevant, and, according to Reeves (Reeves 1994) the prime emphasis is placed on the unique interests, styles, motivations and capabilities of individual learners so that learning environments can be tailored to them (or at least the learner is given the flexibility to customize their own learning context as much as possible). However, research has
shown that with the increased emphasis on learning outcomes, educational paradigms for on-line learning need to emphasize the importance of self-regulated learning and goal directed behavior where professional learners take an intentional orientation towards cognition, become aware of their own learning processes and engage in self-directed learning (Scardamalia and Bereiter 1992).

One of the social development processes that was encouraged and worked quite well in the experiments was reflective teaching. This methodology applies several principles discussed in Chapter 2, namely andragogical theory, as well as situated cognition and apprenticeships, supported by a number of problem solving scenarios. This approach is a constructivist teaching method made unique by catering to different learning strategies and styles. The process requires that the instructor share their own perceptions on the learning content, context, and processes such that students see a ‘justified view’ to the knowledge. The instructor must also encourage them to feel open to form their own rationalizations. This approach as applied here requires the mentor or instructor to share and qualify their views on learning content and process, while encouraging professionals to form their own sensemaking, but at the same time, they need to produce course outcomes (which requires goal setting and regulation). A few studies at the high school level (which can be considered similar enough to apply here), have indicated reflective teaching works well with mature students since flexibility is given for interpreting the learning content, and in adjusting the practices during the course to better serve the needs of the learners (Armstrong and Savage 2002). Research shows that people learn more when they actively collaborate in projects, discuss controversial (interesting) issues, as well as when they teach something they’ve learned to their peers (Andre and Windschitl 2003). From these experiences and based on the literature, reflective teaching requires the instructor to have good personal knowledge of the subject matter, professional knowledge of its practice, and strong project management, planning, and assessment competencies.

The above discussion implies that flexible course plans and outlines are beneficial for professional learning goal approaches. From a professional perspective, an effective learning infrastructure design is achieved through presentation of a flexible syllabi,
which is open to some modification, and each learner must map out (articulate) their own particular learning goals. During the course, the learners self-reflect on their learning progress, in terms of theory, and normative comparisons with their peer’s deliverables. Instructor formative and summative feedback adds to the learner decision making and motivation by pointing out the performance benchmarks and what is needed to bridge the gap between espoused and actual outcomes. Learning plans can be changed during the course within reasonable and practical limits to assist learners achieve their goals.

Creating professional learning flexibility has resulted in much less application of design and sequencing methodologies (outlined in Chapter 2) for these experiments. Many of the instructional design models were applied (explored) in the pilots, but they became checklists in the quasi-experiments (see examples in appendix 8). Part of this rational was due to the nature and purposes of instructional design for online (anywhere, anytime) delivery. The focus of traditional instructional design paradigms has been the creation of a learning event or learning episode for students, in which outcomes are measurable and the process is repeatable in any context. For example, the instructional design model of Dick discussed in Chapter 2 has remained fundamentally unchanged, and until the most recent version, the role and importance of the learning context has also remained unchanged. There has been a consistent emphasis on instructional sequences and on prescribing activities for learners, based on the assumption that all learners are similar and that needs are categorically deterministic. In contrast, the constructivism approach used here with the professional learning goal method, learning rather than instruction is the fundamental model driver, and it challenges the instructional designer to go beyond prescribed sequences and isolated learning episodes. Constructivism challenges the fragmentation of learning into steps, and the whole notion of contemporary instructional design methodologies, and as pointed out earlier, give way to andragogical theoretical driven models (emphasizing the learner as the center of instruction). This transforms the instructor role into that of a facilitator, to help the professional learner find ways to learn.
Chapter 2 discussed design principles and methodologies for constructivist learning environments such as the development of active learning processes, metacognition, multiple perspectives, social engagement and contextually meaningful understanding. In order to design a context for professional learning, the role of the instructional designer is to provide models or guidelines to assist professionals to plan for learning, problem-solving and cognitive outcomes. Research confirms that effective planning for professional learning also requires utilization of technologies as ‘cognitive tools’ (Jonassen 1997) and an understanding of theory relating to learning. This holistic perspective sees learner and teachers as co-participants and learning as engagement in joint tasks, with control over sequences, pacing and learning goals (Harper and Hedberg 1997), and as the research found, the social and motivational context becomes part of the design process. There is evidence in the literature that professional-level learning can be improved by applying these constructivist principles, such as context flexibility, subject matter novelty, openness, and by using groups to promote understanding of perceptual differences (Sheehan 2004).

The emphasis for professional learning goal context development is informed by socio-cultural theory, which was discussed in Chapter 2 as originating in the work of Vygotsky (Duncan 1995) and this concept is also supported in the literature. The Conversational Model is an example of how reciprocal learning activities were found to improve learning, namely interaction, discussion, adaptation and reflection (Laurillard 1995). According to socio-cultural theory all learning is embedded in a social context and all interactions that occur in the social context impact and contribute to learning. As an example of how that was applied in the thesis preliminary research, the cognitive apprenticeship model of learning (Collins, Brown and Newman 1989) was used to offer novices the opportunity to learn from subject matter experts during their cases and assignments. Also, much of the learning took place during online dialogues and real-time virtual classroom lectures, discussions, and presentations. Recent studies of social cognitive contextual learning methods (employing self-efficacy and goal setting approaches) improved learning, specifically finding that participants set work-related goals, took project risks, and perceived they had increased understanding (Cooke 2004).
Technology improves communications between experts and novices more so now than in the past, which suggests our older thinking for instructional design needs to focus more on leveraging the Internet when applying the apprenticeship and situated learning theories. In the earlier pilots and in the thesis experiments, synchronous classrooms, virtual white boards, and asynchronous discussion forums were used very extensively to assist in professional learning and collaboration. Numerous other examples exist in the literature reporting how technology has been leveraged for professional learning, as for example, electronic conferencing, computer-based collaborative learning and asynchronous discussion and idea sharing lead to metacognitive reflection, group commentary and interaction have proven to be very effective (Bonk and Cummings 1998).

In summary, the methodology applied to create professional learning context requires some of the old and some of the new in the sense that the traditional instructional design frameworks can assist, but the andragogical motivation, self-regulation, self-efficacy developmental principles need to be addressed in the learning infrastructure. This professional learning goal methodology is not a distinct list of activities or steps that can be outlined in course guides or e-syllabi – instead they are the principles articulated in Chapter 2, contingently applied by the instructor to improve the learning context, and increase the learner motivation, confidence, and self-regulation. Table 5.3 lists the key principles applied in the professional learning model approach to design the learning context. These recommendations of course also indirectly borrow ideas from the instructional design methodologies and frameworks discussed in Chapter 2.

Table 5.3: Applied Professional Learning Context Design Principles

<table>
<thead>
<tr>
<th>Learning Context Design Activity</th>
<th>Professional Learning Model Approach Best-Practice Idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Implementation through tasks, interaction and learning activities</td>
<td>Create tasks with shared goals, creation and manipulation of ‘shared learning space’. Selectively use outsiders for insights and cooperative tasks (invited vclass presentations and postings in discussion forum).</td>
</tr>
<tr>
<td>2. Create a community of learners to create a motivating context</td>
<td>Use formal and informal communication channels. Formation and/or extension of netiquette rules by learners.</td>
</tr>
<tr>
<td>3. Provide modeling and scaffolding to support the development of expertise</td>
<td>Create learner access to expert models, mentors examples and procedures for dealing with problems. Foster peer scaffolding and mutual support through discussions and group tasks.</td>
</tr>
<tr>
<td>Learning Context Design Activity</td>
<td>Professional Learning Model Approach Best-Practice Idea</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>4. Foster multiple perspectives in order to foster application of knowledge to real life situations</td>
<td>Increase perspectives on issues by designing collaborative tasks, ill-defined problems and case-based reasoning. Provide opportunities to express different points of view through verbal and oral discussion and cooperative tasks.</td>
</tr>
<tr>
<td>5. Contextualise learning activities to develop strategic knowledge</td>
<td>Create anchors, real life scenarios and problems based in authentic contexts. Provide access to same or similar resources used by professionals in the field (e.g. Hoovers financial, eLibrary, etc.).</td>
</tr>
<tr>
<td>6. Enable articulation of ideas and reasoning processes to develop process knowledge</td>
<td>Provide online discussion forums for text based and verbal modes of sharing ideas. Utilise multiple forms of representation such as graphs, charts and diagrams as a basis for online dialogue (async and sync vclass).</td>
</tr>
<tr>
<td>7. Focus on learning processes, not products to cultivate deeper learning</td>
<td>Intentional learning strategies, explicit methods of learning. Use online discussion forums and projects to increase student responsibility and ownership and visibility of learning.</td>
</tr>
<tr>
<td>8. Design problem-based learning tasks to foster mastery of a propositional knowledge base</td>
<td>Ensure that tasks are relevant, authentic and motivating, and have the potential to be defined by learners. Use problem-based learning and tasks requiring research and investigation, and which require comparison of perspectives.</td>
</tr>
<tr>
<td>9. Champion self-reflection to enable learners to challenge personal assumptions</td>
<td>Learners should have the opportunity to compare their performance with experts and other learners at varying stages of competence (e.g. modeling principle). Design collaborative tasks foster metacognition and self-evaluation.</td>
</tr>
</tbody>
</table>

The professional learning contextual approach also emphasizes principles such as cognitive socialization, critical self and peer reflection through dialogues, and collaborative activity for situated learning. Peer and self-assessment practices were observed to improve self-regulation and self-efficacy. Professional project managers (PM) need to foster team building and cooperation skills. Professional PMs also need to offer self and team transformational leadership, they must be very self-directed, and self-motivated in their work. As such these professional learning approaches are strategically aligned in part with what a project manager must do in their work, which should make these principles acceptable and natural as part of continuous learning.

5.5. Inferential Limitations

Chapter 3 outlined very rigorous procedures for maintaining validity and integrity for these quasi-experiments. Both quantitative and qualitative results point to the same conclusion that the professional learning goal approach seems to work. All of the statistical tests which were significant were above the 95% confidence level and most
were above 99%. The quasi-experimental research design isolated the contextual factors and it also ensured the author/instructor effect did not influence the statistical outcomes.

Probably the biggest inferential limitation revolved around the fact no one (even the author) knows exactly, from a scientific and psychological perspective, what factors in the context make the most cause-effect difference in the satisfaction levels and the performance outcomes, and in particular, how the individual learner styles and contextual factors impact the results. Certainly the learning goal approach had a more noticeable positive effect on satisfaction level as compared with actual performance score. This might warrant an ultimatum: would a student be willing to accept this learning goal approach if it could only guarantee 16% improvement in GPV score? What real learning value does an improvement in satisfaction level of 54% constitute? Furthermore, from the instructional point of view, are these effects worth the investment in time and dedication achievable in the adult learning environment? Is a learning goal approach considered an organizational innovation worthy of attention and funding from senior management? Many articles point out the difficulty educational service providers face to balance scarce funding with client learning needs (Nash 2004), which might make the idea of a professional learning goal approach even more attractive to corporations for designing in-house training, as well as for project managers to apply in their self-directed learning.

Going back to the experiment fundamentals, can this approach be understood and replicated by other researchers to further validate or refute the findings in the spirit of good scientific research? And finally, as per the aim of this thesis, can these guidelines and the model really be understood and used to improve professional project manager learning, especially in such a growing global Internet-enable PM practice?

5.6. Professional Meta-Reflections

In reflection of the approach used in this research it is even more clear why it was necessary to reiterate the key underlying humanistic principles underpinning educational psychology in the attempt to suggest an improved professional learning
model. Despite the popularity of constructivism, essentially none of the educational philosophical movements address a holistic stakeholder view of what would work best for the learner, if the learner were considered the unit of analysis. It for this very reason that Ford’s emphasis of collating the individual’s context as a ‘whole person’ was interjected into my adaptation of Honebein’s (Honebein 1996) and Gagné’s (Gagné 1985) models (see Figure 2.7: Professional Learning Context Design Systemic Model in Chapter 2). Constructivism by itself furnishes the principles for real learning, as long as the social development remains part of the context to maintain the link between theory and practice. Cognitive development, behaviorism, and psychoanalytic theories also inform adult learning functions. However, I strongly feel professional learners need the andragogical motivation, self-regulation, and self-efficacy to go beyond learning to learn how to practice and further extend what had been learned. As such, it is the holistic combination of relevant principles from all these epistemological domains that construct a rationalized professional learning model.

In terms of the research paradigms applied in this thesis, the combinations of action science, grounded theory, and empirical experimentation were necessary to discover the rationalistic, explore the logical, return to the realistic, reframe as a positivist interpretation, and pragmatically reflect on the perceptions. As complicated as this may seem, this philosophically represents the complete journey. Furthermore, it is said that new models are developed from theoretical tensions between what is perceived as a true reality, and what actually happens through behaviors. This is true here in that several gaps were uncovered between the rationalized theory, and the qualitative professional feedback. For example, individual learning styles were observed, which made it impossible to structure the learning context (design and delivery the course) in a way to please everyone all the time (as seen by the professional student comments in Table 5.2). The systemic factor model itself confirms that other unknown factors in the context affect learning performance and satisfaction level (see Figure 5.1).

5.7. Conclusion

This genesis of evolving the overall project management practice by developing a strategic approach for improving professional learning itself presented an immutable meta-cognitive dilemma at the preliminary thesis research phase of exploring the ‘what’
could be changed, or the ‘how’ it could be enhanced. It seemed to be of pragmatic relevance to first explore the content issue, which imparted the ‘soft-skill’ theoretical artefacts (leadership, resource/stakeholder management, knowledge creation, meta-learning), were lacking in project manager training. Ironically this also revealed a linear flow of rational causation postulating that teaching and learning approaches did not serve the andragogical immediacy of professionals requiring anywhere, anytime, motivated education. A thorough review of educational psychology theory and principles, combined with a critical reflection of action learning experiences, presented a compelling academic enticement to unfreeze current thinking and build a model to achieve the vision of:

‘Effective and efficient continuous professional learning, desired by working and often ‘mobile’ project managers (subject to frequent work context change), can be achieved through adult learner-centered principles, by harnessing critical epistemology from educational psychology (especially goal-driven motivation, self-efficacy, and self-regulation), while synergistically leveraging all resources’ (Chapter 1).

This legitimate aspiration was itself instigated by the author being unsatisfied as a professional learner and educational provider. The exploration was guided by a thematic map of educational psychology epistemology integrating the objectivist theories of behaviorism, functionalism, and structuralism, to the rationalistic ideologies of cognitive development, constructivism, systems theory, and management science as well as superimposing the humanistic principles underlying psychology, sociology, and contextual development (see Figure 1.2: Thesis Research Meta-Theoretical Framework in Chapter 1). The research was constructed within a stakeholder pyramid of knowledge meta-context that linked educational psychology theory, practice, and actors together, with the focus zoomed on the needs and expectations of the professional learner (see Figure 2.1: Knowledge-Based Macro-View of Professional Learning Theories and Figure 2.2: Systemic Stakeholder View of Professional Learning Context in Chapter 2). The literature review (Chapter 2) presented a hermeneutic interpretation of relevant professional learning concepts emanating from the theoretical domains of psychomotor functioning, psychoanalysis, behavioral conditioning, complex cognitive development,
constructivist knowledge creation, and social learning (Figure 2.3: Educational Psychology Meta-Theoretical Learning Model). These theoretical concepts were connected to practice by reviewing how they are/could be applied to the process of professional learning design and instruction. The repertoire of instructional design methodologies were all individually missing the perceived critical holistic integration of the cognitive, behavioristic, social, and humanistic principles, especially those underlying andragogical motivation, self-regulation, and self-efficacy.

To some extent technology-driven frameworks and systems methodologies reviewed in the latter part of Chapter 2 seem to blur the needs of professional learners, by the relinquishing of physical boundaries in pedagogy, followed by superficially providing virtual training rather than the anytime, anywhere, conceptual learning needed by project managers. As such this research did not focus at all on technology (although it is recognized as a useful tool in the means towards the ends). Instead, the focus was on how professional learning could be improved by leveraging educational psychology, substituting andragogy for pedagogy, and transcendently integrating the behavioristic, cognitive, social, and humanistic disciplines. Thus the rationalistic professional typology proposed at the end of Chapter 2 (see: Figure 2.6: Professional Learning Instruction Process Design Systemic Model, Figure 2.7: Professional Learning Context Design Systemic Model, and Figure 2.8: Synthesized Professional Learning Principles Model) illustrates multiple techniques that are informed by the holistic integration of these relevant theories, which may be applied in combinations to satisfy the particular needs of professional learners. Again the main tenets postulated in this model are professional learner andragogical motivation, self-regulation, and self-efficacy development (emphasized in Figure 2.4: Systemic Model of Self-Regulation, Self-Efficacy, Goal-Setting).

As if the preliminary action learning theory were not enough substantiation to validate the professional learning approach, the grounded theory rationalistic paradigm was accompanied by an empirical methodology to scientifically verify the concept to an acceptable level of statistical significance. In a sense this is our academic way of thinking about ‘learning practice’ as if it were not the ‘real thing’– that is ‘as if reality
hides beneath the phenomenon’ (Heidegger 1962, p. 51). So the concepts need to be proven through behavior and outcomes that we can see and measure. This intellectual delineation between ‘rhetoric and reality’ (Legge 1995) can be overcome by linking theory to practice by identifying cause/effect variables which include the stakeholders, processes, and context (in as much as practical and pragmatic). The last model in Chapter 2 furnishes a rudimentary systemic model that highlights the independent factors and outcome variables to assess to vet this professional learning goal approach (see Figure 2.9: Professional Learning Goal Experimental Factor Model). A point is worth mentioning here that will appease both the economic and social science ideologies, in that both cognitive performance (GPV score) and humanistic outcomes (satisfaction level) were both used for assessment within the quasi-experimental design.

This thesis employed a rigorous scientific multi-method research paradigm combined with industry accepted statistical algorithms to mathematically test the hypothesis in the proposed professional learning model (see Figure 3.2: Philosophical Research Perspective and Methodology, Figure 3.3: Action Learning Theory Development-Testing Cycle, and Figure 3.5: Systems Methodology Applied to Thesis Research, in Chapter 3). Axiomatically, and in keeping with good project management practice, the whole thesis effort (including the scientific multi-method paradigm) was managed under an overarching governance to control scope, quality, stakeholder interfaces, and schedules (see Figure 3.4: Research Project Management Governance in Chapter 3).

The main study of the model consisted of four quasi-experiments structured in factorial paired-treatment design, with two courses being given using business-as-usual fashion, and two other courses applying the professional learning goal approach. The two crucial social research integrity principles applied in the quasi-experiments were: using intact natural enrollments within a commercial university’s MBA and MScs programs; and isolating contextual variable interference by having the same students serve as their own experimental control via pair-wise before/after treatment statistical comparisons.

It is very important to reflectively reaffirm that the multi-method approach of combining grounded theoretical exploration with action science and empirical testing
produces a higher quality and more credible model. It is viewed here that case studies alone, citing literature and quoting stakeholder perceptions cannot scientifically validate a research proposition. Even statistical testing cannot satisfy the scrutiny of the academic community without proper research design and variable control. Experiments can often fall into the pitfall of thinking the results have ‘explained’ phenomena but instead they may have ‘explained away’ true cause-effect leaving the interaction of theory and practice concealed. Measuring only a performance outcome without a qualitative indicator (or vice versa) could equally obscure reality. Assessing before and after conditions without effectively controlling the context will blur the actual impacting factors. In summary, the method is as important as the result, in academic research.

The quasi-experiment tests in Chapter 4 were statistically significant which quantitatively proved the complex theoretical abstractions from Chapter 2 resulted in identifiable cause/effect relationships between the learning approach and the student outcomes. Thus, the professional learning goal approach did improve performance scores and satisfaction levels, with most test results in Chapter 4 surpassing the 99% statistical confidence level. The multiple regression and correlation model building in Chapter 4 provided several linear equations and introduced transformed variables to quantitatively explain more than 66% of the cause-effect between the professional learning goal method (and the other contextual factors) and the dependent variables.

The qualitative discourse in this chapter adds to the quantitative findings of Chapter 4 to bring rational closure to the thesis. Both phenomenological and empirical feedback from the key stakeholder (the professional learner) corroborate that this andragogical motivation, self-regulation, and self-efficacy enhanced approach improves the learning experience. There is no doubt that in these quasi-experiments, the professional learning goal approach produced scientifically identifiable and statistically significant results.

It was of course also realized that a holistic diversity of learning principles and practices nomothetically applied to a professional learner as a ‘whole person’ within a social context cannot be completely irreducible to a mathematical equation or conceptual
abstract. Instead we are left with a good theoretical model to serve as a guideline to inform professional learning.

5.7.1. **Synopsis of Findings**

The key research problems driving this thesis were:
1) What theories would best serve to guide the knowledge creation/learning process;
2) Which learning constructs would best serve global project manager development.

Each of the above problems was investigated through multi-method approaches consisting of grounded theory discovery, action science exploration, and empirical experimentation, resulting in peer-reviewed presentations, journal articles, and peer collaborations preceding this thesis. These research explorations refined the focus of the thesis to developing and testing an improved methodology for ‘how’ to help project managers effectively and efficiently learn. The hypothesis was then established as professional learning could be improved by applying adult learner-centered principles, in particular goal-driven motivation, self-efficacy, and self-regulation, to design and deliver flexible online training, with success determined by measuring the aggregate outcomes of course performance scores and satisfaction levels. The research paradigm transformed into meta-theoretical synthesis, model building, and empirical testing.

At the fulcrum of the research was a proposed professional learning model informed by a holistic integration of philosophy, psychology, sociology, educational psychology, systems thinking, anthropology, and the management science disciplines. This model was framed within an educational psychology epistemology enhanced by those facets that were most relevant to adult learning such as complex cognitive development, social learning, equilibration, knowledge creation and construction. The resulting models for professional learning were driven by the crucial humanistic elements of andragogical motivation, self-regulation, and self-efficacy development (as described in Chapter 2).

A systemic factor model was constructed from the rationalistic professional learning models to scientifically test the theory using a quasi-experiment. The findings were statistically significant at the 95% confidence level (with some test surpassing the 1% level of significance). A transformed multiple regression holistic model was able to
explain up to 66% of the cause-effect between the independent factors, and the professional learning approach, as explained by the experiment’s performance outcomes and satisfaction levels. The result of this research is a holistic constructivist model to serve as a guideline for mentors and learners to apply professional learning goal theories towards improving the global practice of project management (see Figure 5.3).

<table>
<thead>
<tr>
<th>PLANNING</th>
<th>EVALUATION</th>
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<tbody>
<tr>
<td>2. <strong>Value basis:</strong> gap in current PM &amp; educational psychology practices for proven anywhere, anytime, online, adult-centered learning design &amp; instruction.</td>
<td>2. <strong>Focus question:</strong> Can a strategic model be created for anywhere anytime flexible learning design &amp; delivery to advance the PM profession?</td>
</tr>
<tr>
<td>3. <strong>Theory basis:</strong> andragogy and other adult-centered educational psychology principles validated in classrooms, but online training uses undefined models.</td>
<td>10. <strong>Value claims:</strong> something triggered higher performance and satisfaction for 22 of these 48 tuition-paying MBA students, argued to be the course design &amp; instruction based on humanistic-constructivist adult-centered learning principles. The findings can be reviewed, replicated and/or extended.</td>
</tr>
<tr>
<td>4. <strong>Conceptual basis:</strong> phenomenology (action research as student + instructor); theory-grounded model building from humanistic principles (self-efficacy, andragogical motivation flexibility, self-regulation), and social context constructivism (self-schema, meta-cognition); logical positivism through empirical tests in real scenarios.</td>
<td>9. <strong>Knowledge claims:</strong> with course design held constant, instructional delivery using professional learning goal method produced slightly better grade performance and statistically significant (higher) perceived student satisfaction (n=48, r²=66%, p&lt;.001).</td>
</tr>
<tr>
<td>5. <strong>Methods basis:</strong> articulate educational psychology principles underlying PM learning goal model, test online in university quasi-experiment, using professional PM-related subject matter and participants.</td>
<td>8. <strong>Analysis:</strong> rigorous statistical algorithms (parametric and distribution free tests), t-test for dependence, ANOVA + others.</td>
</tr>
<tr>
<td>6. <strong>Objects &amp; events:</strong> integrated action learning experiences (2002-2004) with recent literature and rival theories, created meta-theoretical learning goal model, conducted natural-selection quasi-experiment (2004-2005), published findings.</td>
<td>7. <strong>Data quality:</strong> rigorous paired-treatment experimental design, context controls (legacy survey, same designer, different instructors, repeated measures); factors = design, teaching methods, dependent variables = GPV, satisfaction</td>
</tr>
</tbody>
</table>

Figure 5.3: Synthesis of Thesis Research Project

The final step of the research methodology discussed in Chapter 3 is to articulate the thesis project and findings into a succinct synthesis for the benefit of the academic audience (researcher and students), as well as for the professional PM stakeholders.
Figure 5.3 shows a *Vee Diagram*. This diagram was completed as a synthesis and summary for this project, with each sequential deliverable stage outcome numbered (see section “3.4 Synthesizing Findings for the Research Community” for a background explanation). The next subsection will address the last deliverable of the heuristic to suggest the impacts and next steps. The diagram is a high-level summary and not a substitute for the detail covered in this thesis.

5.8. Closing the Gap in Current Professional Online Learning Practice

Chapters 1 and 2 asserted that current literature did not offer a clear applied model of adult-centered humanistic-constructivist principles for online professional learning (and these contemporary authors were cited: Beaudoin 2002; Gallini and Barron 2002; Johnson and Aragon 2003; Petress 2003; Duffy and Kirkley 2004; Yang 2004a; Maclellan 2005; Muir 2005; Peters 2005; Tynjala and Hakkinen 2005; Waight and Stewart 2005a; Webb, Gill and Poe 2005).

This thesis attempted to overcome the online professional learning shortfall pointed out earlier as: "What has adult education sent back in terms of theory? Not much" (Chapman 2005, p. 310), by sharing new theoretical models and validating them empirically (albeit this thesis and the preliminary research used small samples). Ironically though (as argued at the outset in Chapter 1), the tension in educational psychology literature did not seem to manifest as a lack of epistemology for online professional learning; instead it seemed the principles and means existed, but the integration and applications were not to be found. In fact it was the development and application of a holistic adult learning theory that worked here (as suggested by Briggs 2004; Yang 2004a). The thesis empirical findings were compared with very similar studies (Roussev and Rousseva 2004; Stonebraker and Hazeltine 2004) with the unanimous conclusion that applying humanistic-constructivist principles for online professional learning design and delivery is effective. Therefore, the thesis answer to that question above is the combination of models (and principles) outlined in Chapter 2 can be used to improve the professional online learning design and delivery approach.
5.9. Improving Professional Learning in Project Management

The main implication of these findings on professional project management practice is that mentors, educators, and trainers can apply the principles outlined in this research to create an effective online learning context to service and motivate a busy, often mobile, project manager. Much of the contemporary and historical educational psychology empirical studies focused on children and adolescents in the school environment. In this thesis the focus was moved to the busy adult professional learner. The project management profession can borrow and/or adapt this research to enhance online professional learning, by integrating the relevant principles from educational psychology, management, and social science (outlined in Chapter 2). As pointed out in Chapter 1, organizations that wish to survive need to view intelligent project management learning as a required action learning cycle (Cavaleri and Fearon 2000). Therefore, both professionals and corporations need to promote continuous learning.

The most important point to emphasise from the literature review and theory testing exercise is that these principles and models are not a panacea for a best-practice professional learning design and delivery. Instead, they are guidelines, to be used by project mentors, instructors, and professional learners. The reason for this is that a good project management mentor or instructor will know tacitly how to design and deliver an effective and efficient program to support adult learners. Models may help but they merely become reminders and checklists for seasoned instructors and mentors. Additionally, the learning context design methodologies need to be used – the professional learning models are not a substitute for a good methodical design and delivery process – it is supplemental. The professional learning models emphasise how to go one step beyond basic online instruction to reach a higher-level cognitive and affective plateau of motivated professional learning (for busy project managers), by facilitating their self-regulation and self-efficacy through motivation and goal setting.

This research and theory building has proposed that the professional learning principles and models will help all project managers get ‘on the same page’ of conceptual
understanding, and the theories discussed in Chapter 2 will likely be welcome reading to those entering the role of professional adult educator/mentor for the first time.

Contemporary research argues that even PMs with successful projects need continuous learning because individuals tend to repeat past approaches used on simpler, more defined initiatives, and these may (likely) will not be sufficient for future complex strategic programs (Partington, Pellegrinelli and Young 2005). As mentioned in Chapter 1, project management literature acknowledges the requirement for additional training but it does not articulate the details of how to learn. Busy project managers need structured learning environments which they can access from anywhere, at anytime, yet that which will motivate them to complete the training and allow them to monitor/self-regulate the entire process. This research therefore should be shared with both the academic and business communities. Underpinning this research is the ‘why’ these andragogical theories work in particular for the professional project manager.

5.9.1. Future Research

The learner-centered principles discussed in Chapter 2, combined with the quasi-experiment results discussed in Chapter 4 and here produced a mix of qualitative and quantitative data that shows how and why professional learning can be improved. However rival theories do exist (and were documented), that can be explored.

Additionally, since the size of the experiment to validate the model was 48, and since a single commercial university environment was used, a larger sample size replicated across multiple learning environments would be advisable. As professional managers are just as likely to choose private training institutions in conjunction with universities for continuous learning, the theory should be tested in multiple education service industry contexts. This also makes sense mathematically since the equations I used in my statistical analysis were linear (least-squares as explained in Chapter 3) which actually compares adjacent means and standard deviations for variances, but my recommendation I refer to here for future studies is to make non-adjacent, non-linear comparisons. The most intriguing interpretation was the possible auto-regressive effect associated with a non-linear performance outcome, hypothesized as a second order lag
indicator associated with learning self-efficacy (grades improve slower at first as compared to satisfaction, but later rise from repeated experience with the new context).

Finally, as noted in Chapter 3, this research will continue by the author, as a replication in additional courses (with larger sample sizes to overcome the statistical inference limitations pointed out earlier), with more in depth exploration of the factors and variables. In particular, due to the global and cross-disciplinary nature of project management, additional testing will be done using culture and context as independent factors. Also, the key humanistic principles built into the model should be further isolated as factors and tested to determine (and confirm) their singular interactions, namely these are the andragogical motivation, self-regulation, self-efficacy, and self-schema elements. Furthermore, also as pointed out earlier (particularly referencing: Roussev and Rousseva 2004), future replications should measure the before and after dependent variables of the adult-learners, using reliable instruments such as SAT. This idea can be extended further through replications that test the before and after of humanistic and performance variables in the professional learner to validate the theory.

5.10. Summary
This final chapter presented a critical reflection of the empirical findings by comparing statistical interpretations of the results to the rationalized professional online learning theory articulated from the literature review and action science research. This chapter integrated the strategic analysis of Chapter 1, the rationalized theory articulated in Chapter 2 (which leveraged the adult-centered humanistic-constructivist principles), along with the empirical test results from Chapter 4 (to validate the new approach).

The results from Chapter 4 were scientifically presented with statistical interpretations, and here they were extended by critical reflection into their theoretical dimensions of current and past literature, as well as to validate the theoretical models developed in chapter 2. The value claim presented in Figure 5.3 reiterated that the thesis approaches for course design & instruction did result in higher adult learning performance and satisfaction levels. Finally, this chapter discussed the impacts on the global project management practice (with appropriate statistical cautions), and it closed with recommendations for future research (suggesting replications and larger sample sizes).
6. REFERENCES


Applying Learning Theory to Improve PM

Chapter 6: References


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### 7. GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Action science</td>
<td>Action science examines “…the development themes from which […] practitioners may construct their theories…” (Schön 1983, p. 319), by immersing oneself in the context to better understand the principles (p. 320).</td>
</tr>
<tr>
<td>Actuarial</td>
<td>An actuary is a statistician and mathematician who computes insurance risks and premiums (Houghton-Mifflin 1994).</td>
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<tr>
<td>Andragogy</td>
<td>Andragogy in etymology is from the Greek word &quot;anere&quot; for adult and &quot;agogus&quot; (Houghton-Mifflin 1994), it originates with European educators of 1950 as adult-centered learning. It is known as a contemporary learning theory referring to an adult learner-focused approach in education to differentiate it from pedagogy, which is an instructor-led content-focused style. It emphasizes that adults are self-directed and should take responsibility for decisions (Knowles 1984a). Some literature will spell it as “androgogy”.</td>
</tr>
<tr>
<td>Axiological</td>
<td>Axiology refers to the study of the nature of values and value judgments (Houghton-Mifflin 1994). In this research the terms “axiological” and “axiomatic” are antonyms, the former referring to a scientifically proven understanding (such as through pragmatic efforts), and the latter a self-evident conceptual belief.</td>
</tr>
<tr>
<td>Axiomatic</td>
<td>Of, relating to, or resembling an axiom; self-evident (Houghton-Mifflin 1994).</td>
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<tr>
<td>Behaviorism</td>
<td>Behaviorism is an empiricist educational philosophy that links inputs (such as instruction and studying) directly to outcomes (such as process repetition and memory recall). The main tenet in this school of thought is that behaviors are controllable and predictable, and the best way to understand psychological events (like learning) is through observation… ‘events are verifiable only to the extent that they are reducible to predictions of behavior under specified environmental conditions” (Estes 1950, p. 94).</td>
</tr>
<tr>
<td>Blogs</td>
<td>Blogs are Internet-based threaded discussions organized under topics whereby multiple people collaborate asynchronously.</td>
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<tr>
<td>Classical conditioning</td>
<td>Classical conditioning is the pairing of an action (response) to a stimulus. Ivan Pavlov studied classical conditioning, using the dogs on which he had performed his experiments in digestion. He noticed that the dogs salivated when they heard food being brought to them and found that if he rang a bell each time they were fed, the dogs would eventually salivate at the sound of the bell even when the food was not presented. At the start, the food was the unconditioned stimulus and salivation the unconditioned response. After conditioning, the bell was the conditioned stimulus and salivation became a conditioned response (Grolier...</td>
</tr>
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</table>
### Constructivism
In educational psychology, the constructivist ideology argues knowledge is subjective and personal, mentally constructed in many different ways, as a working hypothesis (Simpson 2002), people are active learners and therefore construct meaning for themselves (Geary 1995), which is influenced by interaction with the social environment (Bandura 1986; 1997). Constructivism emerged to overcome perceived inadequacies of cognitive educational psychology, "to establish meaning as the central concept of psychology" (Bruner 1990, p. 2), and it borrowed principles from psychology, anthropology, sociology, philosophy, and "the humanities" to do so.

### Deduction
Deduction is a method of logical reasoning. It is also the conclusion reached by use of such a method. The deductive method is the method of proof that is used in any situation for which there exists a set of underlying assumptions (axioms or postulates). For example, the deductive method may be used to prove consequences of the laws of algebra and to prove theorems in geometry (Grolier 2002).

### Dialectical constructivism
Also known as “constructed synthesis” as defined by (Moshman 1982, p. 375); from the knowledge management literature, it infers ‘thought’ and ‘experience’ are inextricably intertwined with the learning context and therefore the best way to understand phenomenon is to become emerged within the environment to experience and reflect on its meaning.

### DPM
Acronym for Doctor of Project Management at RMIT university.

### Duetero learning
Also known as “triple-loop learning”, it is an organizational learning principle which posits that people in corporations need to learn to learn by sharing knowledge, reflecting on what they know and have learned, and quite likely companies will need to change their processes to evolve their thinking and/or processes.

### Empiricism
Empiricism is the name of a broad tradition in Western philosophy. The term comes from the Greek empeiria, meaning "experience"; the basic thesis of empiricism is that legitimate human knowledge arises from what is provided to the mind by the senses or by introspective awareness through experience. Most empiricists do not consider knowledge gained through the imagination, authority, tradition, or purely theoretical reasoning legitimate. Hence, they tend to regard traditional claims to knowledge in such fields as art, morality, religion, and metaphysics as unverifiable (Grolier 2002).

### Enumerate
Count off, list, explain, or explore theory.

### Epistemology
The branch of philosophy that studies the nature of knowledge, its presuppositions and foundations, and its extent and validity.
### Formative feedback
In educational psychology, refers to providing students verbose constructive feedback describing what is correct and incorrect, possibly by asking students questions to stimulate their thinking.

### Hermeneutics
Its definition is most closely associated with *Being and Time* (1927) by Martin Heidegger, who proposes that the critic views the large spectrum of elements that make up any work and its full context, by bringing to it his or her own literary, social, cultural, and political context. Heidegger’s work argues that the very condition of being human, more fundamental than the role of being a literary critic, involves a persistent questioning that borders on interpretation.

### HRM
Acronym for Human Resource Management.

### Idealism
Idealism is the philosophical view that the mind or spirit constitutes the fundamental reality, has taken several distinct but related forms. Objective idealism accepts common sense realism, the view that material objects exist (Houghton-Mifflin 1994).

### Idiographic
Relating to or concerned with discrete or unique facts or events: history is an idiographic discipline, studying events that cannot be repeated (Houghton-Mifflin 1994). In research often it refers to case studies, subject observations, which advocates studying individuals (Zechmeister, Zechmeister and Shaughnessy 2001, p. 12).

### Idiosyncratic
Idiosyncratic refers to a structural or behavioral characteristic peculiar to an individual or group, such as a physiological or temperamental peculiarity (Houghton-Mifflin 1994).

### Induction
Induction is a major kind of reasoning process in which a conclusion is drawn from particular cases. It is usually contrasted with deduction, the reasoning process in which the conclusion logically follows from the premises, and in which the conclusion has to be true if the premises are true (Houghton-Mifflin 1994).

### Introjection
In this context *introject* means to incorporate the characteristics of [another] person or object into one’s own psyche [traits] unconsciously (Houghton-Mifflin 1994; Deci and Ryan 1995; Deci, Koestner and Ryan 2001).

### Lassiez-faire
A French expression meaning leave as is, without much effort. In research it refers to the maintaining the ‘Status Quo’ (no change).

### Learning
From an educational psychology/cognitive standpoint, the literature defines learning as: ‘psychologies of subject matter: a focus on developing, learning, teaching, and thinking within the context of specific subject areas; cognitive process instruction: a focus on fostering cognitive processing that leads to meaningful learning’ (Mayer 2003).
<table>
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<tr>
<th>Term</th>
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<tbody>
<tr>
<td><strong>Learning (generic definition)</strong></td>
<td>From the dictionary, learning is described as an &quot;act, process, or experience of gaining knowledge or skill&quot;; in psychology, it is known as &quot;behavioral modification especially through experience or conditioning&quot; (Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td><strong>Logical Positivism</strong></td>
<td>Logical positivism is a 20th-century philosophical movement in the tradition of analytic and linguistic philosophy. Like earlier forms of positivism, it had close ties to British empiricism and was marked by respect for natural science and hostility to metaphysical speculation. Wittgenstein (1921) put forward a general theory of linguistic representation, according to which propositions are &quot;logical pictures&quot; of possible facts. This implied that a proposition is not meaningful unless it determines a precise range of circumstances in which it is true (Grolier 2002).</td>
</tr>
<tr>
<td><strong>Longitudinal</strong></td>
<td>Longitudinal, in research, is used to describe the development of persons or groups over time (Houghton-Mifflin 1994), such as a longitudinal study of leaders or project managers.</td>
</tr>
<tr>
<td><strong>Macrocontexts</strong></td>
<td>Macrocontexts are part of anchored instruction, referring to a sequencing method based on assumptions about the situated nature of learning, whereby it suggests content should be anchored on video-based environments consisting of stories rich with information and problem solving questions.</td>
</tr>
<tr>
<td><strong>Mere-exposure effect</strong></td>
<td>Tendency for neutral or positive but unexpected (or novel) stimuli to be liked more or rated more positive after the participant has been repeatedly exposed, similar to Hawthorne (Babbie 1993).</td>
</tr>
<tr>
<td><strong>Meta-cognition</strong></td>
<td>One of the most fundamental complex cognitive processing components, consisting of &quot;executive&quot; processes that control the strategies and tactics used in ‘intelligent’ cognitive behavior (Mayer, 2003; Schunk, 2004).</td>
</tr>
<tr>
<td><strong>Metaphysical</strong></td>
<td>Metaphysical can be described as an abstract or theoretical view based on speculative or abstract reasoning (Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td><strong>Meta-theoretical</strong></td>
<td>Meta-theory is a theory devised to analyze theoretical systems (Houghton-Mifflin 1994), in other words, study of theories.</td>
</tr>
<tr>
<td><strong>Naturalism</strong></td>
<td>Naturalism is a philosophical position that holds that all that exists is natural, in other words, is part of the spatio-temporal processes of nature, or that if any sort of non-natural object may exist, it is known only through its effects within nature. Moral values, however, may emerge in the relation between human beings as one part of nature and the rest of nature. As part of nature, humans are subject to lawful natural processes; intelligence emerges from the active life of organisms within nature (Grolier 2002).</td>
</tr>
<tr>
<td><strong>Neuropsychology</strong></td>
<td>The branch of psychology that deals with the relationship between the nervous system, especially the brain, and cerebral or mental functions such as language, memory, and perception (Houghton-</td>
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</table>
**Nomothetic**
Relating to the study or discovery of general scientific laws. (Houghton-Mifflin 1994). In research it refers studying the group/organizational level (Zechmeister, Zechmeister and Shaughnessy 2001, p. 12).

**Normative feedback**
In educational psychology, refers to providing students with cultural and social developmental feedback describing what current and past peers have done, and how their outputs relate (compare). This may be considered an element of modeling performance, also known as setting (and measuring) against performance benchmarks.

**Ontological**
Ontological is a more detailed “metaphysical” term often used in research as relating to reality, the essence or the nature of being (Houghton-Mifflin 1994).

**Operant conditioning**
Operant, or instrumental, conditioning is the modification of behavior by the use of rewards, or positive reinforcement. In this type of conditioning, behavior is rewarded a little at a time, which gradually leads to an entire series of behaviors being performed. E. L. Thorndike’s Law of Effect states that the connection between a given stimulus and response is increased when the response is followed by positive reinforcement. Thorndike believed that success or reward furthers learning while punishment or negative reinforcement hinders it. Thorndike’s Law of Exercise states that stimulus-response bonds are also strengthened by repetition. Operant conditioning differs from classical conditioning, in that rewards and punishment are contingent on behavior (Grolier 2002).

**Paradigm**
A set of assumptions, concepts, values, and practices that constitutes a way of viewing reality for the community that shares them, especially in an intellectual discipline (Houghton-Mifflin 1994).

**Pedagogy**
The theory or science of teaching, mostly referring to children (Houghton-Mifflin 1994).

**Phenomenology**
Phenomenology is a school of philosophy whose principal purpose is to study the phenomena, or appearances, of human experience while attempting to suspend all consideration of their objective reality or subjective association. The phenomena studied are those experienced in various acts of consciousness, mainly cognitive or perceptual acts, but also in such acts as valuation and aesthetic appreciation (Grolier 2002).

**Physiomotor**
Study of learning associated with the anatomy and physical movement (coordination and skills), such as in athletics (Houghton-Mifflin 1994).

**PM**
Project Management or Project Manager depending on context.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positivism</td>
<td>Positivism is a philosophical movement characterized by an emphasis upon science and scientific method as the only sources of knowledge, a sharp distinction between the realms of fact and value, and a strong hostility toward religion and traditional philosophy, especially metaphysics (Grolier 2002).</td>
</tr>
<tr>
<td>Posteriori</td>
<td>Derived by or designating the process of reasoning from facts or particulars to general principles or from effects to causes; inductive; empirical; justified by appeal to experience (Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td>Pragmatism</td>
<td>In philosophy, a movement consisting of varying but associated theories, distinguished by the doctrine that the meaning of an idea or a proposition lies in its observable practical consequences; and also meaning a practical, matter-of-fact way of approaching or assessing situations or of solving problems (Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td>Priori</td>
<td>Proceeding from a known or assumed cause to a necessarily related effect; deductive; derived by or designating the process of reasoning without reference to particular facts or experience; made before or without examination; not supported by factual study (Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td>Procurement</td>
<td>Procure is to get by special effort; obtain or acquire: managed to procure a pass; to bring about; effect: procure a solution to a knotty problem (Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td>Psychoanalysis</td>
<td>System of psychology originated by Sigmund Freud in the 1890s and then further developed by him, his students, and other followers, consisting of three kinds of related activities: (1) a method for research into the human mind, especially inner experiences such as thoughts, feelings, emotions, fantasies, and dreams; (2) a systematic accumulation of a body of knowledge about the mind; and (3) a method for the treatment of psychological or emotional disorders (Grolier 2002).</td>
</tr>
<tr>
<td>Psychographics</td>
<td>The use of demographics to study and measure attitudes, values, lifestyles, and opinions, such as for marketing purposes (Babbie 1993; Houghton-Mifflin 1994).</td>
</tr>
<tr>
<td>Psycholinguistics</td>
<td>Psycholinguistics is a hybrid discipline created out of the psychologist’s interest in language and the linguist’s interest in psychology. The major concerns of psycholinguistics are the psychological processes involved in encoding or speaking, in decoding or comprehending, and in acquiring language. Some would claim that the ultimate aim of psycholinguistics is to describe the operation of that portion of the brain dealing with language (Grolier 2002).</td>
</tr>
<tr>
<td><strong>Rationalism</strong></td>
<td>Rationalism is a theory that contends that the most fundamental knowledge is based on reason and that truth is found by rational analysis of ideas independent of empirical data, emotive attitudes, or authoritative pronouncements. Rationalist beliefs, essentially philosophical, have significantly influenced science and religion as well (Grolier 2002).</td>
</tr>
<tr>
<td><strong>Recency effect</strong></td>
<td>An experimental or case study phenomenon suggesting participants will remember or be most influenced by the last (most recent) information or theory presented, which is the opposite of (and less common than) the primacy effect, the latter meaning that, other things being equal, people are most influenced by the information or principles first presented (Babbie 1993).</td>
</tr>
<tr>
<td><strong>Social facilitation</strong></td>
<td>The strengthening of dominant (prevalent, likely) responses from sample participants caused by the presence of others (research observers and/or experimenters); originally meaning the tendency of people to perform simple or well-learned tasks better when others are present, similar to Hawthorne effect (Babbie 1993).</td>
</tr>
<tr>
<td><strong>SQ3R</strong></td>
<td>An acronym for ‘survey, question, read, recite, review (Robinson, 1961), also part of programmed instruction (Skinner, 1958).</td>
</tr>
<tr>
<td><strong>Summative feedback</strong></td>
<td>In educational psychology, refers to establishing assessments of cognitive learning (knowledge) and providing students concise feedback as to what is correct and incorrect, usually with marks.</td>
</tr>
<tr>
<td><strong>SWOT</strong></td>
<td>An acronym in management science referring to strategic planning and marketing: Strengths, Weaknesses, Opportunities, and Threats.</td>
</tr>
<tr>
<td><strong>Transmogrify</strong></td>
<td>Transmogrify is used here as it often applied to modifying existing PM courses (both face-to-face and online versions), to transform them into a learner-centered approach, and to apply the professional learning goal principles. From the dictionary, transmogrify refers to ‘change into a different shape or form, especially one that is fantastic or bizarre…convert’ something (Houghton-Mifflin 1994).</td>
</tr>
</tbody>
</table>
Dear Sponsoring Organization:

I am a research candidate in the Doctor of Project Management (DPM) program at RMIT University. The purpose of the DPM program is to advance project management practice. To date, my academic qualifications comprise a Master of Business degree, majoring in Information Technology, a Graduate Diploma in Business, and a Bachelor of Applied Science degree in Computer Science. I have 21 years of PM experience. I am writing to request the assistance of your organisation/project team members in providing data to support my research project, which is to examine methods of improving learning through computer-mediated (online internet-based) project management courses.

My research is based on the hypothesis that courses built on principles underlying organizational learning theory will be more effective as measured by student achievement and satisfaction; delivery methods which embody emergent leadership techniques will improve adult learning outcomes as measured by course marks and peer participant feedback. My research activities are intended to investigate this hypothesis and provide a basis for advancing project management practice.

Due to the practical nature of my research topic, I am dependent on the participation of willing business/project stakeholders. Therefore the opportunity to work with your organisation/project will be of great assistance. Currently, I anticipate this assistance to take the form of having several of your staff / students voluntarily take one of my online organizational behavior / project management modules and then provide feedback.

I will respect the privacy of your organisation, both during and after the course of my research activities. I will ensure that all data and comments provided to me remain coded and secure to protect your right to confidentiality; including any mention of my research findings in conference papers and/or journal articles. I am a self-funded doctoral research student and receive no funding for this work.

I fully respect your right to withdraw for your voluntary support of my research at any time. In addition, should you wish to clarify any issues regarding my research, please contact the Business Faculty Human Research Ethics Committee, phone: (03) 9925 5594 (email: rdu@bf.rmit.edu.au). I anticipate that your support of this research will improve the global project management practice.

Yours sincerely,

Kenneth Strang, Doctor of Project Management candidate
(Ken.Strang@excite.com)
### Appendix 2: Sample Survey Instrument

#### I. Existing University Survey – Completed by Adult Learner

<table>
<thead>
<tr>
<th>A. Course Content</th>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The table of contents was clear</td>
<td>0 Not Applicable</td>
</tr>
<tr>
<td>2. The course was structured well</td>
<td>1 Strongly Disagree</td>
</tr>
<tr>
<td>3. The course had sufficient breadth</td>
<td>2 Disagree</td>
</tr>
<tr>
<td>4. The course had sufficient depth</td>
<td>3 Neutral</td>
</tr>
<tr>
<td>5. The exercises were relevant and fair</td>
<td>4 Agree</td>
</tr>
<tr>
<td>6. The overall workload was fair</td>
<td>5 Strongly Agree</td>
</tr>
</tbody>
</table>

#### B. Course Delivery

<table>
<thead>
<tr>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same as above</td>
</tr>
</tbody>
</table>

10. What suggestions do you have for our delivery team?  
[Short answer]

#### C. Service

<table>
<thead>
<tr>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Not Applicable</td>
</tr>
<tr>
<td>1 Strongly Disagree</td>
</tr>
<tr>
<td>2 Disagree</td>
</tr>
<tr>
<td>3 Neutral</td>
</tr>
<tr>
<td>4 Agree</td>
</tr>
<tr>
<td>5 Strongly Agree</td>
</tr>
</tbody>
</table>

14. Administrative personnel were reliable and helpful when asked  
[Short answer]

15. What suggestions can you provide us that will help us service you better?  
[Short answer]

#### D. Overall

<table>
<thead>
<tr>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Not Applicable</td>
</tr>
<tr>
<td>1 Strongly Disagree</td>
</tr>
<tr>
<td>2 Disagree</td>
</tr>
<tr>
<td>3 Neutral</td>
</tr>
<tr>
<td>4 Agree</td>
</tr>
<tr>
<td>5 Strongly Agree</td>
</tr>
</tbody>
</table>

20. Other suggestions or comments?  
[Short answer]

#### II. Supplemental Web-based Course Evaluation Survey

<table>
<thead>
<tr>
<th>A. Additional Questions – Completed by Adult Learner</th>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. The instructor demonstrated sufficient course coordination and leadership (organizing content and meetings, explaining processes, motivating students, interacting with students, applying effective learning methodology).</td>
<td>0 Not Applicable</td>
</tr>
<tr>
<td>22. The course was clearly designed, easy to follow, with links between content and goals</td>
<td>1 Strongly Disagree</td>
</tr>
<tr>
<td>23. The scheduled student activities were relevant to theory &amp; goals, and timely</td>
<td>2 Disagree</td>
</tr>
<tr>
<td>24. The assessments (tests and assignments) were relevant to theory &amp; goals, and timely</td>
<td>3 Neutral</td>
</tr>
<tr>
<td>25. Do you have any additional constructive comments or improvement suggestions about the course design, content, delivery method, or instructor style?</td>
<td>4 Agree</td>
</tr>
<tr>
<td>26. Do you have any additional constructive comments or improvement suggestions about organizational support, course improvement, and/or student effort/participation?</td>
<td>5 Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Additional Questions – Completed by Instructor</th>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Sufficient and timely administrative, technical staff, technology/material resources, were provided</td>
<td>0 Not Applicable</td>
</tr>
<tr>
<td>27. Sufficient and timely instructor continuous improvement and development was encouraged</td>
<td>1 Strongly Disagree</td>
</tr>
<tr>
<td>28. Program level design, monitoring and evaluation were appropriate</td>
<td>2 Disagree</td>
</tr>
<tr>
<td>29. Do you have any additional constructive comments or improvement suggestions about organizational support, course improvement, and/or student effort/participation?</td>
<td>3 Neutral</td>
</tr>
<tr>
<td>30. The instructor demonstrated sufficient course coordination and leadership</td>
<td>4 Agree</td>
</tr>
<tr>
<td>31. The students demonstrated sufficient effort and performance</td>
<td>5 Strongly Agree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Additional Questions – Completed by Organizational Management / University Mgt.</th>
<th>Response Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>30. The instructor demonstrated sufficient course coordination and leadership</td>
<td>0 Not Applicable</td>
</tr>
<tr>
<td>31. The students demonstrated sufficient effort and performance</td>
<td>1 Strongly Disagree</td>
</tr>
<tr>
<td>32. Do you have any additional constructive comments or improvement suggestions about the course design, content, delivery method, or instructor style?</td>
<td>2 Disagree</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Additional Questions – Completed by Peer Instructors (Where Familiar with Course and Instructor)</th>
<th>Response Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>32. Do you have any additional constructive comments or improvement suggestions about the course design, content, delivery method, or instructor style?</td>
<td>Short answer – by peers</td>
</tr>
<tr>
<td>Pseudoname</td>
<td>Student#</td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>PeterG</td>
<td>LXP013</td>
</tr>
<tr>
<td>David</td>
<td>LXS055</td>
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<tr>
<td>Andrew</td>
<td>LXR021</td>
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<tr>
<td>Charlie</td>
<td>LXC025</td>
</tr>
<tr>
<td>Kevin</td>
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<tr>
<td>Cindy</td>
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<td>Tracey</td>
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<td>Kendall</td>
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<td>Shanadeca</td>
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<tr>
<td>Jack</td>
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<td>Peter</td>
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<td>Simri</td>
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<td>Frank</td>
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<td>Ihab</td>
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<td>JamieM</td>
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