Volume 14, No. 6
November 2016
ISSN: 1545-679X

INFORMATION SYSTEMS EDUCATION JOURNAL

In this issue:

4. IS Design Pedagogy: A Special Ontology and Prospects for Curricula
Leslie J. Waguespack, Bentley University

14. Teaching Information Systems Courses in China: Challenges, Opportunities, and Lessons for US Educators
Meg Fryling, Siena College
Jack Rivituso, SUNY Cobleskill

20. Progression of a Data Visualization Assignment
Joni K. Adkins, Northwest Missouri State University

27. Agile Preparation within a Traditional Project Management Course
Jeffrey P. Landry, University of South Alabama
Rachel McDaniel, University of South Alabama

34. Building I.S. Professionals through a Real-World Client Project in a Database Application Development Course
RJ Podeschi, Millikin University

41. Using a Multimedia Final Project in an IT Ethics Course
Elizabeth V. Howard, Miami University Regionals
David M. Woods, Miami University Regionals

47. A Longitudinal Analysis of the Reid List of First Programming Languages
Robert M. Siegfried, Adelphi University
Jason. P. Siegfried, Adelphi University
Gina Alexandro, Adelphi University

55 Edugamifying Media Studies: Student Engagement, Enjoyment, and Interest in Two Multimedia and Social Media Undergraduate Classrooms
Robert Bajko, Ryerson University
Jaigris Hodson, Royal Roads University
Katie Seaborn, University of Toronto
Pamela Livingstone, Ryerson University
Deborah Fels, Ryerson University

The **Information Systems Education Journal** (ISEDJ) is a double-blind peer-reviewed academic journal published reviewed published by **ISCAP,** Information Systems and Computing Academic Professionals. The first year of publication was 2003.

ISEDJ is published online (http://isedj.org). Our sister publication, the Proceedings of EDSIGCon (http://www.edsigcon.org) features all papers, panels, workshops, and presentations from the conference.

The journal acceptance review process involves a minimum of three double-blind peer reviews, where both the reviewer is not aware of the identities of the authors and the authors are not aware of the identities of the reviewers. The initial reviews happen before the conference. At that point papers are divided into award papers (top 15%), other journal papers (top 30%), unsettled papers, and non-journal papers. The unsettled papers are subjected to a second round of blind peer review to establish whether they will be accepted to the journal or not. Those papers that are deemed of sufficient quality are accepted for publication in the ISEDJ journal. Currently the target acceptance rate for the journal is under 40%.

Information Systems Education Journal is pleased to be listed in the 1st Edition of Cabell's Directory of Publishing Opportunities in Educational Technology and Library Science, in both the electronic and printed editions. Questions should be addressed to the editor at editor@isedj.org or the publisher at publisher@isedj.org. Special thanks to members of AITP-EDSIG who perform the editorial and review processes for ISEDJ.

Information Systems Education Journal

IS Design Pedagogy: A Special Ontology and Prospects for Curricula

Leslie J. Waguespack
lwaguespack@bentley.edu
Computer Information Systems
Bentley University
Waltham, MA 02452

Abstract

Design as an academic endeavor has a rich history in the visual and performing arts as well as the "construction" arts: architectural, industrial, graphic, interior, fashion, and landscape design. Design in the natural and commercial sciences is largely peripheral. Although not ignored, design in the sciences predominates as a dialect of problem-solving rather than artifact creation. Information Systems (IS) as a fusion of computer science and business struggles with the identity and role of design as it leans heavily on its roots in mathematics and formal logic with the scattered influences of statistics (data analysis) as practiced in research among the social and behavioral sciences. Design as a practical skill is a critical ingredient in successful information systems. Yet, design as a distinctive element in programs and curricula of IS and computing is (at best) haphazardly diffused - if not completely omitted. This paper presents a special ontology of design to frame the opportunities and justification for conscious and deliberate design pedagogy in IS and computing education. It presents an example of integrating design pedagogy into existing object modeling and data management syllabi by tailoring design quality guidelines to the specific paradigm.

Keywords: Information Systems Curriculum, Information Systems Design, Thriving Systems Theory, and Special Ontology of Design.

1. INTRODUCTION

Information systems engage myriad issues: audience, purpose, function, materials, and economics. Successful development requires gathering alternatives to be assessed, weighed, balanced and selected to eventually result in a deliverable – a confluence of design choices that *is* the system – *design-as-a-noun*. It is curious that *design-as-a-verb* is not a core focus in contemporary information systems (IS) education. The closest approximation to design as a learning goal is perhaps *problem solving*. If anything, design as a goal in IS curricula has diminished rather than grown. If we inspect IS model curricula as surrogates for defining the discipline it is clear that "… [the] distinction between design and implementation has faded from the structure of computing education. To ignore the conceptual distinction between the *design* and an *implementation* is tantamount to accepting any 'solution' without even considering quality…" (Waguespack, 2011)

Within the business domain that envelopes IS education, the theme of "design" has become *de rigueur*, particularly as it relates to creativity (Cohen, 2014). Design expertise is recognized in industry as a recognized competitive advantage. Apple Inc. is a revered corporate leader, not just in technology, nor just as an innovator in the marketplace, but particularly because of its marked, tenacious, and steadfast focus on the importance of design (Turner, 2007). Design thinking is a prominent tool in solving social as well as commercial challenges. "… Large organizations such as the Bill and Melinda Gates Foundation, the Rockefeller Foundation, the Hewlett Foundation, and others, have enthusiastically embraced design thinking. At the same time, non-profit design companies like D-Rev, Design that Matters, … IDEO.org, and others are collaborating with social entrepreneurs and NGOs to bring exciting new innovations to those most in need. For perhaps the first time in the history of design, it's possible to make a career designing for the social sector" (Brown, 2009).

Design has long been held in esteem in the arts, and particularly in architecture (Alexander, 2002). Design taps into the human capacity for emotive response (aesthetics); not readily evoked by mathematics or algorithm. All but ignored in computing education, design's value is primarily relegated to achieving computing artifacts that "work." But, in this current, technologically based culture, the distinction between a system that "works" and one that "works well!" determines the success or failure of websites, mobile applications, and enterprise systems. The collection of design choices that form a computing artifact produces a stakeholder experience that may range wildly from unacceptable to elegant depending on the skill and insights of the designer(s). There may have been an era when "functional" was an adequate and acceptable level of design quality. But that era has past. Today's individual, corporate, or governmental consumer expects computing artifacts that "delight" by delivering a level of satisfaction that not only "works" but, anticipates, simplifies, and empowers the users at their task. IS professionals must be able to partner in the organizational role of design; thus design, both as noun *and* as verb, must be integral to computing education.

This paper presents a special ontology of IS design as a pedagogical platform for understanding and integrating design in IS and computing curricula. This paper proceeds as follows: First, there is a brief, selected review of design research in computing. Next perspectives on design in the sciences, humanities and design thinking are contrasted. A special ontology of design defines the objects and actions behind a descriptive narrative of design behavior. There is an example of integrating design pedagogy in existing IS courses using Thriving Systems Theory in a metaphorical lens on design quality. Finally there is a brief reflection of the ongoing pedagogy experiment using these ideas and future directions.

2. DESIGN RESEARCH IN IS

In IS research there is a renewed interest in design; a recognition that design quality should not be insignificant or accidental in systems development. Design Science research has become a movement (Hevner & Chatterjee, 2010) and Information Systems Design Theory (ISDT) promises to formalize quality systems assessment (Walls, 2004, Gregor, 2007).

Design in the object-oriented paradigm evolved from art and physical architecture in Christopher Alexander's pattern languages and the notion of design patterns (Alexander, 1977, 1979; Gamma et al., 1995). Alexander identified the "Quality without a Name," or perhaps, a *je ne sais quoi* capturing the essence of designing – "to speak of design is to speak of quality" (Alexander, 1979). Alexander's theory of *living structure* inspired Thriving Systems Theory of design quality in information systems (Alexander, 2002; Waguespack, 2010; Waguespack & Schiano, 2012, 2013). There is an arc of design influence from Christopher Alexander, to the "Gang of Four," to Ward Cunningham and Kent Beck, as manifested in object-orientation, the Unified Modeling Language, design patterns, and agile methodologies (Beck et al., 2001).

3. DESIGN: ARTIFACT AND EMERGENCE

There are widely varied conceptions of design across three cultures of theory: the natural sciences, the humanities, and design thinking (Simon, 1966). (See Table 1 below adapted from Cross, 2007.)

	Phenomenon	Methods	Values
Science	The natural world	Controlled experiment, classification, analysis	Objectivity, rationality, neutrality, "truth"
Humanities	Human experience	Analogy, metaphor, evaluation	Subjectivity, imagination, commitment, "justice"
Design	The artificial world	Modeling, pattern-formation, synthesis	Practicality, ingenuity, empathy, "appropriateness"

Table 1. Conceptions on Design

The natural sciences dwell on "why" objects in nature exist as they do – basically taking intact, functioning "objects" apart to see what they are made of and how they work. Objects are accepted, as they are, independent of human intention or judgment. "The 'value' of an object in the natural sciences view vests in its existence and/or survival with any human satisfaction based on 'accident of nature' (Babb & Waguespack, 2014).

The humanities, on the other hand, ascribe an artifact's "value" to intention and judgment in the human encounter with the artifact that prompts a psychological or emotional response (i.e. a degree of satisfaction) – specific to the observer. This perspective contemplates the observer's mindset and expectations. But as with the natural science perspective the artifact is perceived as extant – valued for its *design-as-a-noun* with little or no consideration of the artifact's origin or emergence.

The heritage of IS's treatment on design closely aligns with the positivist philosophy of mechanistic or mathematical artifacts, extant phenomena as in natural science – the essence of these phenomena existing independent of human judgments and devoid of aesthetic quality. Design science research has incorporated a human dimension to *design-as-a-noun* but, treats computing artifacts fundamentally as "block boxes," extant and similar to natural phenomena, but evaluable in human terms.

Unlike the natural sciences or humanities, *design thinking* champions the creative aspect of design – *design-as-a-verb*.

> "The central idea of design is 'the conception and realization of new things'. It encompasses the appreciation of 'material culture' and the application of 'the arts of planning, inventing, making and doing. At its core is the 'language' of 'modeling;' it is possible to develop students' aptitudes in this 'language', equivalent to aptitudes in the 'language' of the sciences (numeracy) and 'language' of humanities (literacy). Design has its own distinct 'things to know, ways of knowing them, and ways of finding out about them'. … That is the distinctive character of a *designer*." (Cross, 2007, p.17).

This conception of design resonates with the core competency that identifies IS professionals – *conceiving and crafting systems*. This competency is the focus of the quality design pedagogy addressed in this paper.

> "Design quality in IS artifacts entails: 1) a grasp of functional needs, 2) an aesthetic sensibility attuned to the stakeholder(s)' perception of quality and 3) the skill to engage technology that allows a formulation of (1) which allows (2) to resonate. Design in this formulation of quality is central to the entire IS discipline: technology, society, organization, management, and operation – every relevant aspect of IS" (Babb & Waguespack, 2014).

4. A SPECIAL ONTOLOGY OF IS DESIGN

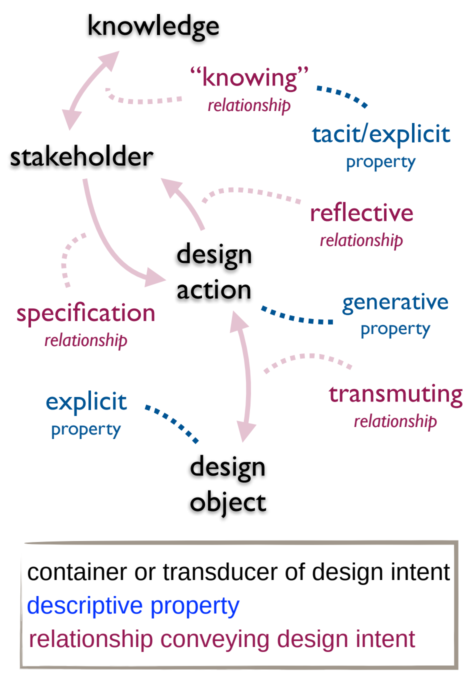


Figure 1 - Special Ontology Of Design

Design is often portrayed as a discrete phase in the systems development life cycle (SDLC). It actually permeates the entire SDLC. Design, as the "conception and realization of new things," is integral to every SDLC work product, both individually and in composition by acts of *design-as-a-verb*. Every work product results from design choices that shape, include, exclude, and juxtapose various alternatives in policy, documentation, specification, interfaces, algorithms, program code, procedures, acceptance and performance standards, protocols, software, training exercises, contracts, etc. Design behavior involves a cycle of decomposing the design space and compositing design choices in an intrinsically recursive activity. A special ontology follows that enumerates the objects and actions characterizing design.

Special ontologies identify individuals, attributes, relationships, and classes defining relevant concepts of interest that establish a framework for reasoning within a specific domain. The special ontology that follows explains a general theory of design. (See Figure 1.)

(Gero, 1990) and (Gero & Kannengiesser, 2002) offer ontologies focused specifically on design element manipulation.

Individuals – *Stakeholders*, *knowledge*, *design objects*, and *design actions* comprise this special ontology of design. A *stakeholder* is a human agent invested in creating an artifact (i.e. client, owner, user, designer, or consumer). *Knowledge* denotes the sum of facts and skills personally accessible to a stakeholder. A *design object* is an explicit proposition of stakeholder intention, a *model*: a) directly specified by the stakeholder, or b) the result of a design action. A *design action* is a generative activity that: a) creates a design object specifying stakeholder intention, b) transmutes a design object from one form into another as a step in fabricating an artifact, or c) delivers a design object to a stakeholder for reflection.

Attributes (properties) – Design objects record *explicit* knowledge (i.e. published). Stakeholders access their knowledge through *explicit* or *tacit* "*knowing*." A stakeholder can specify/explain their *explicit* knowledge (i.e. knowledge acquired through formal education) and be aware of but, not be able to specify/explain their *tacit* knowledge (i.e. knowledge acquired through their personal experience of "living"). This is the distinction between knowing "what" and knowing "how" (i.e. "*We know more than we can tell*") (Polanyi, 1966). Design actions are *generative*.

Relationships - Stakeholders associate with their knowledge through an *explicit* or *tacit* "*knowing*" relationship, and with design actions through *specification* and *reflective* relationships. Design actions associate with design objects as input or output through a *transmuting* relationship.

Classes distinguish generative design actions as *specification, transmuting,* or *reflective*. *Specification* publishes stakeholder intentions by creating a design object. A *transmuting* design action reshapes an existing design object from one form into another in its progression toward the target artifact (e.g. a stakeholder intention is specified as a design object, which is transmuted to become a requirement specification, which is transmuted to become a design specification, which is transmuted to become a prototype, etc., etc.). A *reflective* design action provides a stakeholder access to a design object for reflective evaluation, to assess a degree of satisfactory progress (or possible completion) (Schön, 1983, p. 271).

A normative depiction of design behavior follows based upon this special ontology of design (Figure 1 above).

5. A PROTOTYPICAL DESIGN NARRATIVE

Design behavior is characterized by three intrinsic concerns: "*why*," "*how*," and "*what*." (See Figure 2 below.)

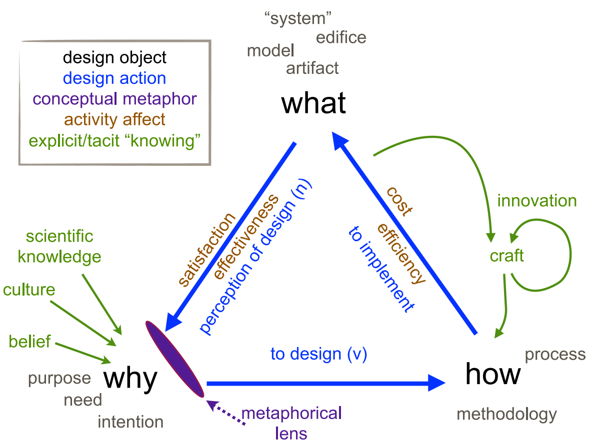


Figure 2 - Design Behavior

"Why" encompasses the intentions that originate from stakeholders and motivate the design process – the "qualities" that describe the desired artifact. These qualities take the form of needs or purpose that reflect a call for change in the status quo – in general creating a "new experience" for the stakeholder(s). The qualities prescribed in the "*why"* are guided, directed, and/or constrained by the stakeholders' mindset, their world-view. That mindset reflects the combined explicit and tacit knowledge sourced from formal education and personal experience. Conscientious stakeholders try to act objectively by eschewing unnecessary or irrelevant influences on their specification of "*why*." But, human beings find it sorely difficult to achieve total objectivity in their world-view shaped by culture, geography, politics and beliefs inculcated through family, society, and life experience. As the stakeholder(s)' intentions enter into the "*why*" of design, they are necessarily colored by a personal world-view depicted in Figure 2 as a *metaphorical lens*.

The **first action of design behavior** is creating a design object, a *requirements* proposition, ostensibly accurately and fully representing the stakeholder(s)' "*why*." A sincerely objective expression of the *"why"* should avoid artifact implementation details. They are poor substitutes for a clear statement of desired artifact qualities.

"How" – The **second design action** (*design-as-a-verb*) transmutes the *"why"* into a plan of instructions, materials, and protocols to be followed/executed using available tools and skills to construct an artifact. Unless those tools and skills reflect heretofore unknowns, implementation is an execution of *craft*. *Craft* is acquired through successful practice on similar implementation projects and assures predictable outcomes with reliable cost and quality. *Craft* strongly influences design choices in transmuting requirements into a plan of construction. *Innovation* seeks to improve *craft* – reduce costs and increase efficiency. With an implementation plan in hand the construction steps are executed to produce a provisional artifact.

"What" is that provisional product of construction aspired to in the *requirements* proposition. The product may be material or informational: document, program, system, or, perhaps, machine or edifice. Regardless, only at this point can its value be assessed. It is provisional because a perfect alignment of artifact qualities with stakeholder intentions is a veritable impossibility. Artifact acceptability is inevitably "satisficing" (to some degree) (Simon, 1996 p. 119).

The **third design action** is reflective, evaluating the *"what."* The stakeholder(s) compares the qualities they perceive in the artifact (*design-as-a-noun)* against their understanding of intention in the "*why*." The degree of perceived equivalence determines *satisfaction*. The same *metaphorical lens* used to shape the *"why"* mediates the stakeholder(s) perception of the *"what"* – this time in reflection rather than specification (Schön, 1983, p. 271). In an iterative design process unacceptable misalignment of the *"what"* with the *"why"* prompts rethinking and/or adjustments to requirements (clarifications, corrections, additions, etc.) with a repeat of the cycle of design actions in order to improve stakeholder(s) *satisfaction*.

6. PROSPECTS FOR CURRICULA

Although IS model curricula have paid virtually no attention specifically to design (Waguespack, 2011), its pervasive impact across every aspect of the SDLC (and the Agile variants vying to supplant the SDLC) manifest the need to acknowledge design's importance and to find its place in IS and computing curricula. By "factoring" the design narrative above potential focus areas emerge.

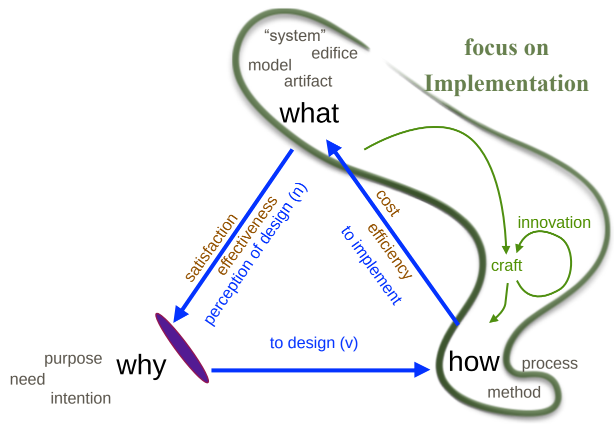


Figure 3 - Implementation Pedagogy Focus

Implementation focus - Programming languages, application platforms, and pattern languages mark a focus on implementation that commonly constitutes the software development dimension of computing pedagogy. (See Figure 3 above.) While the model curricula focus primarily on syntax and coding, particularly computer science and computer engineering, more emphasis is needed on design.

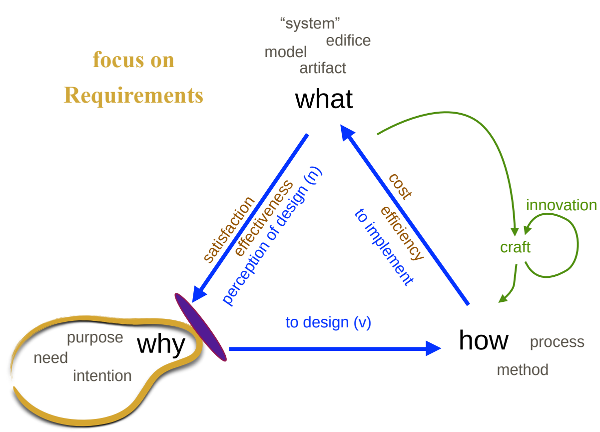


Figure 4 - Requirements Pedagogy Focus

Requirements focus – Requirements engineering is preoccupied with business rules and organizational interdependencies. This focus is often deemphasized in computer science curricula while it predominates IS curricula housed in schools of business. (See Figure 4 above.) The pivotal role of the *metaphorical lens* can be a balance point for analyzing business model and information system alignment.

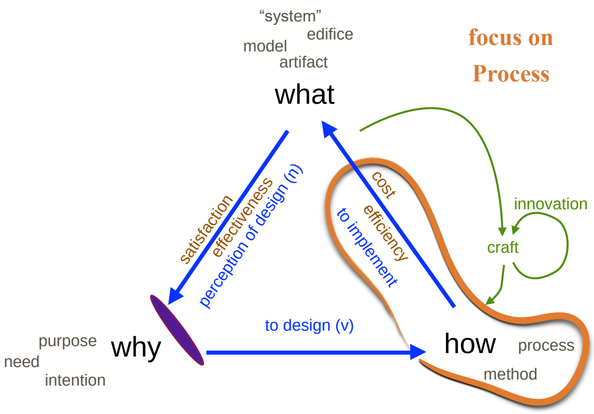


Figure 5 - Process Pedagogy Focus

Process focus – Software engineering (in particular) emphasizes life cycles, methodologies, and metrics. Team and project productivity are clearly impacted by "*why/how*" alignment in both project and process management. (See Figure 5 below.) Concern for aesthetic qualities can improve documentation, reuse, training, customer support, and maintenance – all aspects of cost of ownership.

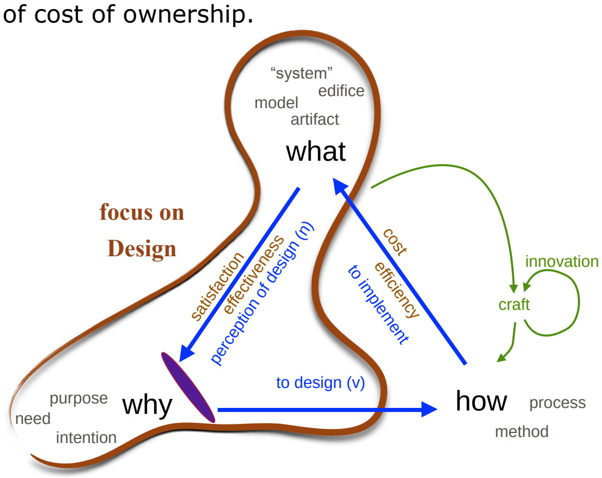


Figure 6 - Design Pedagogy Focus

Design focus – *"Design"* as a discipline encompasses design thinking, creativity, and reflective practice that shape a comprehensive professional design competency (Schön, 1983, p. 271). The *metaphorical lens* is fundamental to designer formation. Design pedagogy should nurture a design mindset through readings, exercises, and projects (individual and team) that develop the student's "design muscle memory" by ingraining a tacit "*knowing*" of design quality through practice and reflection with IS tools and methods guided by master designers. (See Figure 6 below.)

These four "slices" of design focus can only hint at the possibilities. The next section outlines an example of an integration experiment across three course syllabi.

7. DESIGN INTEGRATION STRATEGY

A strategy for design pedagogy must navigate the constraints of graduation requirements, accreditation and the general politics that impact program design in collegiate curricula.

Add on – As is the case with many topic areas perceived as value-added to degree programs in higher education, "add a course" to the graduation requirements appears to be the most straightforward approach. If this is feasible, the opportunity for design coverage may be quite broad. If a school of design is available, a general survey of design principles may be appropriate. Practically speaking, adding a course is more often not feasible.

Integrate – Integrating design pedagogy into existing coursework is the alternative to adding on a new course. For example, for the past five years a design integration one IS program has been experimenting with integrating design pedagogy in three existing course syllabi: Business Systems Analysis and Modeling (UG), Object-Oriented Systems Analysis and Design (GR) and Data Management and System Modeling (GR). These courses involve constructing SDLC artifacts (i.e. requirement specifications, data models, database schema, SQL queries, transactions, UML models, etc.). Each is a three-credit hour one-semester course packed tightly with learning objectives. Students in courses like these naturally fixate on objective issues: syntax, query results, error-free execution, etc. Any aesthetic flavor of design quality is a rather exotic concept to them. So, the goal of integrated design pedagogy in these courses is to instill an aesthetic sense of design quality.

> "In order to formulate a design problem to be solved, the designer must frame a problematic design situation: set its boundaries, select particular things and relations for attention, and impose on the situation a coherence that guides subsequent moves" (Schön, 1983).

Choice Property	Design Action	Action Definition
Modularization	modularize	employing or involving a module or modules as the basis of design or construction
Cohesion	factor	express as a product of factors
Encapsulation	encapsulate	enclose the essential features of something succinctly by a protective coating or membrane
Composition of Function	assemble	fit together the separate component parts of (a machine or other object)
Stepwise Refinement	elaborate	develop or present (a theory, policy, or system) in detail
Scale	focus	(of a person or their eyes) adapt to the prevailing level of light [abstraction] and become able to see clearly
Identity	identify	establish or indicate who or what (someone or something) is
Patterns	pattern	give a regular or intelligible form to
Programmability	generalize	make or become more widely or generally applicable
User Friendliness	accommodate	fit in with the wishes or needs of
Reliability	normalize	make something more normal, which typically means conforming to some regularity or rule
Correctness	align	put (things) into correct or appropriate relative positions
Transparency	expose	reveal the presence of (a quality or feeling)
Extensibility	extend	render something capable of expansion in scope, effect, or meaning
Elegance	coordinate	bring the different elements of (a complex activity or organization) into a relationship that is efficient or harmonious

Table 2 – TST Choice Properties

The objective is to expand the student's *metaphorical lens* by imprinting aesthetic sensibility as part of that *coherence* to guide their design choices. The design choice properties defined in Thriving Systems Theory (TST) provide the quality framework in this experiment (Waguespack, 2010, Waguespack & Schiano, 2013). TST "seeds" their *metaphorical lens* with design quality concepts for *naming* and *framing* design elements and actions: a) specifying stakeholder intentions, b) preserving stakeholder intentions in design actions, and c) evaluating artifact features in "reflective conversation" (Schön, 1983, p. 271).

Thriving Systems Theory defines fifteen properties underpinning quality choices in computing artifact design. (See Table 2 above.) Each property is strengthened by a generic action that when applied properly enhances design quality. The first six properties differentiate structural design features while the remaining nine differentiate aesthetic aspects that together impart a sense of stakeholder satisfaction – a sense that the artifact serves as intended, as expected, or is "as it should be."

The IS or computing professional will readily recognize the first six properties in Table 2 as desirable properties in computing structures like documentation, source code, abstract data types, data models, or modularity. They are all primarily static characteristics amenable to counting, measuring, i.e. – numeracy! The remaining nine properties basically defy numeracy because they prompt personal, emotional, or psychological observer reactions – reactions mediated by the observer's personal disposition and knowledge, their world-view. Every design choice exhibits each of these fifteen properties with a subtlety that renders it near invisible, a pronounced conspicuousness, or to some degree in between. Although individually present, the properties are more often perceived in confluence, in a broader sense of design quality. Discerning design quality is akin to recognizing a person's face, physiognomy, even when the human observer is unable to distinguish or quantify specific facial features that confirm the subject's identity. This is "tacit knowing," a demonstrable human competency, accomplished without specifiable knowledge, a practical skill acquired through personal experience. (Polanyi, 1966, p.17)

Design quality clusters – TST comprises fifteen choice properties of design inscribed along the circle's circumference in Figure 7 above. The confluence of the six properties of design structure appears in the convergence of the pair-wise combination of their property affects – shaded in pink. The six properties cluster to articulate progressively complex, structural qualities described more thoroughly in (Waguespack, 2010). The remaining nine properties likewise cluster to articulate progressively complex aesthetic qualities more readily interpreted through analogy rather than numeracy – shaded in green. In progressive pair-wise composition the clusters *frame* and *name* the stakeholder's impression of the artifact in their learning of it, their use of it, and adapting/modifying it, – where the stakeholder is *indwelling* with the artifact, assimilating a sense of the artifact as part of the stakeholder's "world."

> "The use of the term 'indwelling' applies here in a logical sense as affirming that the parts of the external world that we [assimilate] function in the same way as our body functions when [skill becomes second nature]. In this sense we live also in the tools and probes which we use, and likewise in our intellectual tools and probes." Mitchell quotes Polanyi (Mitchell, 2006).

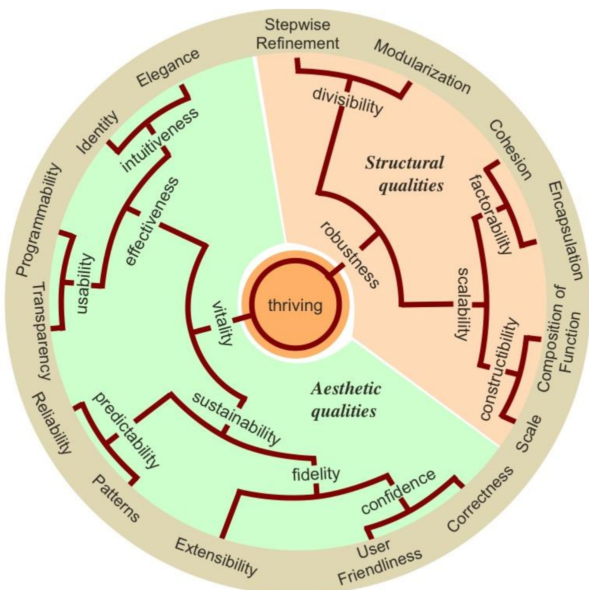


Figure 7. Design Quality Clusters

Accommodating multiple paradigms – The design actions strengthening choice properties in Table 2 are generic – paradigm independent. The structural and aesthetic qualities depicted in Figure 7 are explicated by those generic design actions. But, students must learn to build artifacts using tools and objects specific to a particular modeling paradigm with its own design space "language".

To map TST design quality onto paradigm-specific design actions requires a *paradigm lens* through which design actions specific to the paradigm are interpretable in terms of TST design quality. A *paradigm lens* comprises: 1) a special ontology of that paradigm: individuals, attributes, relationships, and classes, and 2) design guidelines that associate the TST property design actions with corresponding actions in the specific paradigm. Where Thriving Systems Theory provides the lens onto design quality, the paradigm-specific special ontology and design guidelines provide the *paradigm lens* to focus on individual manipulations of paradigm-specific constructs to guide quality design choices.

The three courses in the design integration experiment share two paradigms: the relational and the object-oriented. The accompanying *paradigm lens* for each may be accessed in the literature (Waguespack, 2013 & 2015a). Lectures on Thriving Systems Theory and paradigm-specific ontology form the design pedagogy accompanied by design choices examples to illustrate choice properties. The courses employ the ontological terminology of the respective paradigms throughout. The design pedagogy continues to evolve with the experience of teacher and student.

8. DISCUSSION

This paper argues there is clear evidence that computing artifact design is a crucial professional competency and deserves concerted effort in IS and computing education. The special ontology and narrative of design delineate the fundamentals of the design process and highlight coursework opportunities. Where course credit hours are in short supply, adding design to a curriculum may (more often than not) require integrating design into existing courses. The integration scheme for these three courses demonstrates a feasible approach that is potentially elegant if carefully aligned with existing course objectives. Thriving Systems Theory and the paradigm-based special ontologies not only illuminate design quality but also, add theoretical depth to the pedagogy of the respective paradigms.

The special ontologies pose challenges for undergraduate students. However, feedback indicates that after the initial "shock" of studying object-orientation or relational modeling through ontology, later the "light goes on" when the same terminology clarifies the evaluations of their design products. Graduate students dosed twice with the TST design pedagogy report the pleasant surprise that the ontologies make team communication more clear and that TST design actions simplify their models.

Expanding this pedagogy approach to other topic areas is under consideration: agile development methodologies, virtual machine organization, and cloud based security architecture (Waguespack & Schiano, 2012; Waguespack, Yates & Schiano, 2014; Waguespack, 2014; Waguespack, Schiano & Yates, 2015).

9. REFERENCES

Alexander, C., Ishikawa, S. & Silverstien, M. (1977), *A pattern language: towns, buildings, construction*; Oxford University Press, London.

Alexander, C. (1979) *The timeless way of building*, Oxford University Press, London.

Alexander, C. (2002). *The nature of order an essay on the art of building and the nature of the universe:* Book I - The Phenomenon of Life, The Center for Environmental Structure, Berkeley, CA, 2002.

Beck K., Beedle M., van Bennekum A., Cockburn A., Cunningham W., Fowler M., Grenning J., Highsmith J., Hunt A., Jeffries R., Kern J., Marick B., Martin R.C., Mellor S., Schwaber K., Sutherland J., & Thomas D. (2001). *Manifesto for Agile Software Development*. Retrieved July 9, 2013 from agilemanifesto.org

Babb, J. S., Waguespack, L. J. (2014). In search of a design-focus in IS curricula, *Information Systems Education Journal, 12(4) pp 29-39. HTTP://isedj.org/2014-12/ ISSN: 1545-679.*

Brown, T. (2009). *Change by design*, HarperCollins, New York, NY.

Cohen, R. (2014). Design thinking: a unified framework, Forbes Online, www.forbes.com/sites/reuvencohen/2014/03/31/design-thinking-a-unified-framework-for-innovation/ (accessed 7/6/2015).

Cross, Nigel (2007), *Designerly ways of knowing*, Birkhäuser Verlag AG Berlin.

Gamma, E., Helm, R., Johnson, R., and Vlissides, J. (1995), *Design patterns: elements of reusable object-oriented software*. Addison-Wesley, Boston.

Gero, J. S. (1990), Design prototypes: a knowledge representation schema for design, *AI Magazine*, 11(4), pp. 26-36.

Gero, J. S. & Kannengiesser, U. (2002), The situated function-behaviour-structure framework, *Artificial Intelligence in Design '02*, Kluwer Academic Publishers, Dordrecht, pp. 89-104.

Gregor, S. & Jones, D. (2007), The Anatomy of a Design Theory, *Journal of the Association for Information Systems*, 8(5), 312-335.

Hevner, A. and Chatterjee, S. (2010). *Design research in information systems: theory and practice*, Springer, New York, NY.

Medina, R. (2008). Christopher Alexander still matters. http://www.regismedina.com/blog/2008/04/christopher-alexander-still-matters. Accessed June 15, 2013.

Mitchell, M.T. (2006). *Michael Polanyi*, Intercollegiate Studies Institute, Wilmington, DE.

Schön, D. (1983). *The reflective practitioner: How Professionals Think in Action*, Basic Books, New York, NY

Schön, D. (1983). *Educating the reflective practitioner*: Jossey-Bass, San Francisco, CA

Simon, H. (1996). *The* sciences *of the artificial*, 3rd Ed., M.I.T., Cambridge, MA

Turner, D. (2007), The secret of Apple design, MIT Technology Review, http://www.technologyreview.com/featuredstory/407782/the-secret-of-apple-design/, Accessed July 10, 2015.

Usher, R., & Bryant, I. (1989), *Adult education as theory, practice and research: The captive triangle*. Routledge, London.

Waguespack, L.J. (2010). *Thriving systems theory and metaphor-driven modeling*, Springer-Verlag, London.

Waguespack, L. (2011). Design, The "Straw" Missing From the "Bricks" of IS Curricula, *Information Systems Education Journal,* 9(2) pp 101-108. http://isedj.org/2011-9/ ISSN: 1545-679X.

Waguespack, L.J. & Schiano, W.T. (2012). SCRUM Project Architecture and Thriving Systems Theory. *45th Hawaii International Conference on System Science (HICSS)*, 4943-4951, 4-7 Jan.

Waguespack, L.J. & Schiano, W.T. (2013). Thriving Systems Theory: An Emergent Information Systems Design Theory. *46th Hawaii International Conference on System Science (HICSS)*, pp.3757, 3766, 7-10 Jan. 2013

Waguespack, L. (2013). A Design Quality Learning Unit in Relational Data Modeling Based on Thriving Systems Properties, *Information Systems Education Journal*, 11(4) pp. 18-30. http://isedj.org/2013-11/ ISSN: 1545-679X.

Waguespack, Leslie J., Yates, David J., Schiano, William T. (2014), Towards a Design Theory for Trustworthy Information Systems, 47th Hawaii International Conference on Systems Sciences, Hawaii, HI.

Waguespack, L. (2014) Computer Security Primer: Systems Architecture, Special Ontology and Cloud Virtual Machines. *Information Systems Education Journal*, 12(2) pp. 18-28. http://isedj.org/2014-12/ ISSN: 1545-679X.

Waguespack, L. (2015), A Design Quality Learning Unit in OO Modeling Bridging the Engineer and the Artist, *Information Systems Education Journal*, 13(1) pp. 58-70, http://isedj.org/2015-13/ ISSN: 1545-679X.

Waguespack, Leslie J., Schiano, William T., Yates, David J. (2015). "Trust = Utility + Security: Designing for that elusive quality in cloud computing," *The International Journal of Design in Society*, Champaign, IL (to appear)

Walls J.G, Widmeyer, G.R. & El Sawy, O.A. (2004). Assessing Information Systems Design Theory in Perspective: How Useful was our 1992 Initial Rendition?, *Journal of Information Technology Theory and Application*, 6(2), 43-58.

Walsham, G. (1993). *Interpreting information systems in organizations*. John Wiley & Sons, Inc., Hoboken, NJ

Teaching Information Systems Courses in China: Challenges, Opportunities, and Lessons for US Educators

Meg Fryling
mfryling@siena.edu
Computer Science
Siena College
Loudonville, NY
12211, USA

Jack Rivituso
rivitug@cobleskill.edu
Business and Information Technology
SUNY Cobleskill
Cobleskill, NY 12043, USA

Abstract

In Fall of 2014, as a result of a Chinese faculty visit to an upstate New York college to observe American pedagogical techniques in teaching information systems, two US faculty members were invited to teach two separate courses at a vocational college in southeast China. The courses to be taught in China were selected by the Chinese faculty and college administration. The specific courses to be taught were on the topics of computer applications and management and database foundations and applications. This paper is a reflection of the two American faculty members on their experiences teaching information systems courses at a vocation college in southeast China. The objective of this work is to describe their experiences teaching in China, to identify pedagogical differences, and to describe the challenges, rewards, and lessons learned of this type of endeavor.

Keywords: China, Pedagogy, ESL, Database first course, Hands-on learning, culture

1. BACKGROUND

Vocational education is of paramount importance to the rising economic giant that China is becoming (Aggarwal & Goodell, 2011). To support this skyrocketing growth, the Chinese Ministry of Education has come to realize the important role that vocational education plays in the future prosperity of this nation. Thus, in order to prepare its students for employment in the manufacturing industry, curriculums in schools must contain a close connection between course subject matter and job related skills. Their goal then, is for courses and curriculums to be developed that contain a balance between the theoretical concepts of a given subject and practical hands-on skills that allows students to gain marketable skills that suit them well for employment upon graduation (Liang, 2013; Xu, 2014).

Chinese students begin to learn English in the sixth grade and this continues throughout high school and in vocational schools (Infeld & Wenzhao, 2009). The Chinese have recognized that English is an international language and that to be an effective participant in the global market, learning English is essential (Changlin, 2013; North & Shelton, 2014; Zengtao, 2012).

The scholarly literature on the topic of pedagogical differences between American teaching and learning styles and those of the Chinese suggest that the Chinese style reflects a Confucian influence (Smith, 1973; Thakkar, 2011; Wu, 2008). This influence centers on the premise that hard work leads to success and also to the development of critical thinking skills in students. Furthermore, the Chinese education system emphasizes that hard work is more important to student success than individual ability (Thakkar, 2011). Chinese students traditionally learn by memorization and are generally accustom to quiet listening of lectures versus the student-centered active learning that is popular in the United States and intended to develop critical thinking skills (Chen, Bennet, & Maton, 2008).

2. INTRODUCTION

In Fall of 2014, as a result of a Chinese faculty visit to an upstate New York college to observe American pedagogical techniques in teaching information systems, two US faculty members were invited to teach two separate courses at a vocational college in southeast China. The courses to be taught in China were selected by the Chinese faculty and Chinese college administration. The specific courses to be taught were on the topics of computer assembly and management (CAM) and database foundations and applications (DFA).

As agreed upon by both the US and China institutions the courses were to be taught in English in the same format as they would be taught at the US institution. As such, English textbooks were selected for both courses and all course materials were prepared in English. While the students had taken English courses these did not include technology related courses taught in English. Therefore, students were given access to the textbook PowerPoint slides approximately one month ahead of time to allow for some translation. In addition, the Chinese faculty met with the students for approximately 8 hours before the English instructors' arrival to introduce the students to some of the technical concepts that would be introduced in these courses (e.g. Motherboard, Ethernet, relation, tuple, primary key).

The student cohort included 55 students. Per the US faculty request, the group was split into two cohorts of 27 and 28. One group took the CAM course in the morning (8:20-10:55am) and then the DFA course in the afternoon (1:15-3:40pm). The second group had the exact opposite schedule. The DFA classroom included a computer for each student, while the CAM classroom had limited computers and required some students to bring their laptops to class. Classes met four days a week for four weeks in June 2015. For both courses, assessment consisted of various in-class activities and four quizzes, one of which was cumulative. Both instructors dropped the lowest quiz grade.

3. CHALLENGES, OPPORTUNITIES, AND LESSONS LEARNED

Culture and Language

While the students had several years of English, communication was more difficult than anticipated. The cohort were freshman and had not taken English courses at the university level. Additionally, the material being presented was technical and likely introduced many English words that were completely new to them. As with all students, some comprehended English better than others, but the pace of the course had to be slowed significantly to mitigate language challenges. After the first day of classes the US faculty requested interpreters be available in the classroom to overcome the language barriers. However, the Chinese faculty and administrators stated that in their experience, the students would over rely on the interpreter and not attempt to understand the material in English, instead waiting for the Chinese translation. In their opinion, this defeated a major goal of having a course taught by a native English speaker.

The Chinese faculty indicated that the students were able to understand written English much better than hearing it spoken. However, it is important for them to hear the words too in order to help them improve their English pronunciation. While the courses being taught were technical in nature, it became clear that an additional major goal of the courses was to improve the students' English skills. This realization shifted the teaching strategies of both instructors. Concepts were presented on PowerPoint slides, spoken slowly, repeating each sentence several times, and writing the same concept on a whiteboard with a variety of synonyms. It was necessary to pause frequently for the students to hear the concepts, see the related text written, translate what they heard and read into Chinese, and then respond back in English. Frequently referencing related textbook pages and highlighting key words also seemed to help the students.

The students were not always comfortable telling the US instructors when they were lost so it became exceedingly important to read body language signals. When in doubt the faculty would ask the students if they would like additional text written on the whiteboard. The students always answered in the affirmative and it was clear that this helped tremendously as you would typically hear the students reading the text as it was being written, often followed by affirmative acknowledgements of understanding such as "oooooohhhh".

Infeld and Wenzhao (2009) explain that their experience in trying to communicate to non-native English speakers helped to make them more aware of clarity in their presentation style when teaching back home. The US instructors' experiences teaching these courses corroborate those of Infeld and Wenzhao (2009). While language difficulties were a major barrier in the first week of teaching, for most students the comprehension of spoken and written English seemed to improve as the weeks progressed.

Typically, these US instructors do not allow cellphone use in their US classrooms but they quickly discovered they needed to relax this rule in the Chinese classroom for two main reasons. One, the culture of the school seemed to be that cellphone use by students in the classroom was considered acceptable. This fact was not only told to the US faculty by the Chinese faculty but it was clearly observable in the classes taught by Chinese faculty. Secondly, and perhaps more importantly, the students would frequently use cellphones as translation tools. Nonetheless, cellphone use in the classroom could quickly become a distraction and the instructors did find that they needed to impose some restrictions. As with US students, it is easy for cellphones to be a major distraction including text messaging and gaming. The CAM instructor found that when he did completely restrict cellphone use, the quiz grades improved.

Technical

In addition to the obvious challenges of language and cultural differences, there are a variety of technical issues to overcome when teaching in another country. Operating systems and application software will likely be in the local language. While the classrooms had both English and Chinese operating systems and software installed, the students often used the Chinese version. This can be challenging when attempting to assist students with problems, particularly error messages. Ideally, all students would use the English version but some students really struggled with English and were more comfortable using the Chinese version. As such, we did not require them to use the English version. Obviously, the icons are the same and if you are familiar with the software it is possible to navigate fairly well with some translation assistance from the students. Even the English version of the software would frequently try to translate what was being typed to Chinese, making modifications to PowerPoints on the fly and web searches challenging (see Figure 1). The automatic translation adds single quotes as you type and translates to Chinese characters.

Figure 1: Browser Search Automatic Chinese Translation

The office computer, which offered printing capabilities, had a Chinese operating system and software. If you are familiar with the software shortcuts printing is possible but again, if you receive error messages, it can be problematic (see Figure 2). A network printer that can be accessed via a personal computer is likely the best option but it is important to bring a laptop with Ethernet capabilities and the proper printer drivers installed. The US instructors brought home institution laptops for which they did not have administrator rights. Therefore, it was not possible to install any software including the printer drivers needed for the printer provided.

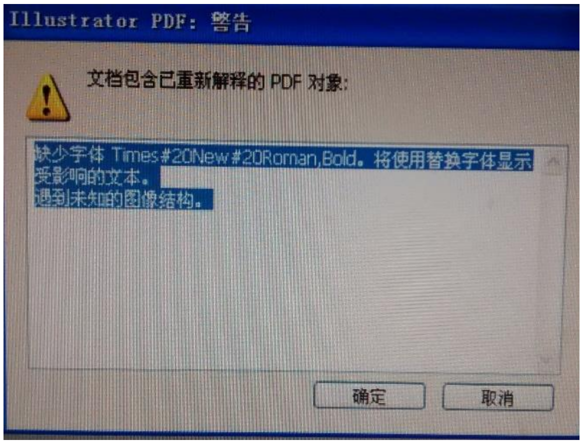


Figure 2: Microsoft Word Error Message

Some tools regularly used by faculty and students in the US are unavailable in China, such as all Google products. If you rely on Google Drive to access your teaching materials, you should download all materials locally to your computer ahead of time. If you use Gmail you may need to create another account and forward your Gmail to that account while in China. Note that many higher education institutions in the United States host their email with Google so these accounts will be blocked in China as well. Another option to overcoming these restrictions is to use a Virtual Private Network (VPN). China has begun blocking VPN protocols, including corporate VPNs, but there are some available that still work. Nonetheless, do not rely on the VPN working, always have a few backup plans. While the VPN did work on the apartment WiFi network, it did not work at the school. In addition the WiFi available at the school was very unreliable and was frequently unavailable. This was particularly challenging since one of the instructor's personal computers did not have Ethernet capabilities.

Exchanging files with students and student submission of work was not ideal. The host institution provided a file server to use but the US instructors were never able to successfully connect to it. As a workaround, the DFA instructor typically emailed the needed files for class the night before. The students all had qq.com email accounts, not institutional accounts which are typical in the US. As such, the DFA instructor's emails were often marked as spam by qq.com, even when only sending to a single class section of 28 students. The students would submit their completed work via email as well, which can be clunky to work with for review and grading purposes. An additional challenge was that all students logged into the school computers using the same credentials. That meant that the afternoon students could see the completed files of the morning students and some simply submitted these instead of completing the work on their own.

Pedagogy

The findings of the two US faculty support those of Smith (1973), Wu (2008), and Thakkar (2011) that the Chinese students tend to learn by memorization and do not typically contribute to the class discussion unless called upon by the professor. While a couple students were willing to answer questions without being called on, most required the instructors to call on them by name to participate and were extremely nervous when doing so. Certainly part of their hesitation was likely due to fears regarding speaking in English and taking a class with an instructor they did not know. Some researchers have suggested that many Chinese students experience stress and anxiety when instructors ask a lot of questions, and that this may even negatively impact their learning (Huang & Rinaldo, 2007). Since the host school was interested in providing their students the "US pedagogical experience" active-learning was an integral part of that experience. Therefore, the instructors were careful to ease student fears by encouraging them as they struggled to respond in English and giving praise even when answers were incorrect. As the weeks progressed participation without being called on did improve a bit.

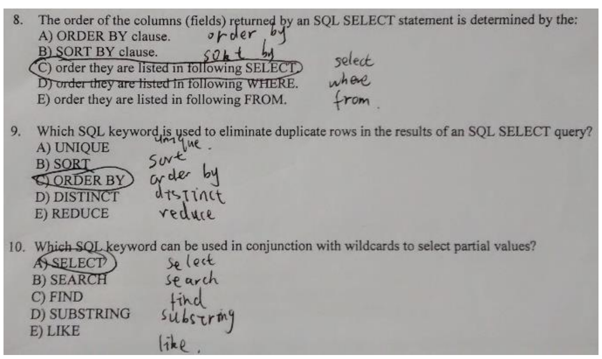
Many students seemed to struggle with being able to use an example to help them answer a related question. Often they would simply answer a different question with an exact example given earlier by the instructor or listed in the textbook. This could potentially be a result of the memorization style of learning the Chinese students are accustomed to. To mitigate this challenge the instructors attempted to use multiple examples for the same problem and tried to clarify how these are just examples and not *the* singular answer. Nonetheless, this was a frequent recurring challenge during both lecture discussions and quizzes.

As with any classroom, not all students are motivated to learn. It seems privacy of student education records is not much of a concern as there is no FERPA or equivalent in China. As such, some of the visiting teachers used this to help get unmotivated students' attention regarding poor performance. These instructors showed the spreadsheet of all student grades to the class regularly so everyone could see who is

ISSN: 1545-679X November 2016

doing poorly (i.e. not turning in assignments). Those faculty did report that this seemed to motivate some students but certainly not all. The US faculty chose to not use this particular strategy but did find that several students needed to be "threatened" with failure several times to get their attention.

Approximately halfway through the course the host institution met with the US faculty to discuss progress and any challenges. The students reported to the Chinese faculty that the use of uppercase words was a struggle for them. The CAM instructor typically wrote in all capital letters on the whiteboard and had to learn to adjust this habit in order to help the students with translation. Many words in the DFA course were typically written in uppercase (e.g. SELECT, ORDER BY), including in the textbook. It seemed students need to "translate" these uppercase words to lowercase words in order to understand (see Figure 3).


8. The order of the columns (fields) returned by an SQL SELECT statement is determined by the:
A) ORDER BY clause.
B) SORT BY clause.
C) order they are listed in following SELECT.
D) order they are listed in following WHERE.
E) order they are listed in following FROM.

9. Which SQL keyword is used to eliminate duplicate rows in the results of an SQL SELECT query?
A) UNIQUE
B) SORT
C) ORDER BY
D) DISTINCT
E) REDUCE

10. Which SQL keyword can be used in conjunction with wildcards to select partial values?
A) SELECT
B) SEARCH
C) FIND
D) SUBSTRING
E) LIKE

Figure 3: Database Foundations and Applications (DFA) Quiz

Unlike most US college students, Chinese students are not accustom to homework assignments that are expected to be completed outside of the classroom (Schell, 2014). As such, the US instructors gave adequate class time to complete all required assignments. Therefore it is imperative to have the appropriate resources in the classroom to allow the students to complete their work. In the case of technology related courses, this includes access to computers with the appropriate software.

4. CONCLUSIONS

While teaching in the Chinese classroom, the instructors became very aware of the importance of every word spoken. The language challenges made them very conscious of the speed of their speech, the clarity of their speech, and the need to avoid the use of slang. Lecture became a very conscious task even though the US faculty were very comfortable with the subject matter and experienced at teaching such courses in the United States. At times the instructors felt like they were moving at glacial speed only to find out at the end of class that most of the students had difficulty understanding. The take away from this experience was that faculty must be vigilant and always conscious when lecturing and discussing subject matter in the classroom. Although one may feel that we have made the point crystal clear, it is important to recognize that there may be students in the classroom that just did not understand.

Teaching in another country is a unique journey that allows one to embed themselves in the daily life and culture of that country, providing a deeper understanding than a traditional tourist experience. In addition to the Chinese faculty at the host institution, there were three Australian faculty members teaching courses in business and engineering. The US faculty were afforded the opportunity to meet, socialize, establish friendships, and exchange teaching ideas with these faculty. The interactions and relationships with foreign faculty introduced new ideas for teaching and, since two of the three Australian faculty members have taught in China for many years, their experiences teaching in China helped the US faculty adjust their pedagogical methods and techniques to adapt to the needs of their Chinese students. Their advice included:

- Be more flexible with the pace of the course so that the students have adequate time to process the lecture material and translate the concepts from English to Chinese.
- Use more hands-on activities so the students can immediately apply what they have just learned. This also provides early and more frequent assessment of learning goals, which helps determine the appropriate pace for the course.
- Use multiple types of assessment. In addition to quizzes/exams, include various assignments and presentations (individual and team).

The experience of teaching abroad can help faculty understand the host country better, in this case China, including students from that country. As more students from other countries come to the US to study, an increased understanding of their culture and unique needs offers tremendous benefits to both the international students studying in the US and the US institutions hosting them.

There are a variety of opportunities for US educators to teach in China. These faculty just need to be prepared to adjust their typical pedagogical methods, slow their pace to accommodate language barriers, and have workarounds for technical limitations.

5. ACKNOWLEDGEMENTS

The authors would like to thank the host institution in China for their limitless hospitality. They would also like to acknowledge the generosity and friendship of the visiting Australian faculty, whose knowledge of the area and experience teaching at the host institution was invaluable.

6. REFERENCES

Aggarwal, R., & Goodell, J. (2011). Introduction: Importance of Teaching International Business in Greater China: Some Challenges and Opportunities. *Journal of Teaching in International Business, 22*(3), 145-148.

Changlin, S. (2013). Probing Possibilities of Applying Productive Pedagogy to English Teaching in China. *Theory & Practice in Language Studies, 3*(9), 1651-1657.

Chen, R., Bennet, S., & Maton, K. (2008). The adaptation of Chinese international students to online flexible learning: Two case studies. *Distance Education, 29*(3), 307-323.

Huang, J., & Rinaldo, V. (2007). Factors affecting Chinese graduate students' cross-cultural learning. *International Journal of Applied Educational Studies 4*(1).

Infeld, D. L., & Wenzhao, L. (2009). Teaching public administration as a Fulbright Scholar in China: Analysis and reflections. *Journal of Public Affairs Education, 15*(3), 333-347.

Liang, X. H., Xuefen. (2013). On Higher Education in in China and Canada from the Perspective of Humanity Orientation *Interchange, 43*(2), 167-180.

North, C., & Shelton, N. (2014). Advancing English Language Learning in China through Multimodal Content Area Teaching. *Journal of Curriculum & Instruction, 8*(2), 68-88.

Schell, G. (2014). *Preliminary Results: Critical Thinking and Communication Skills of Chinese Students.* Paper presented at the Information Systems Educators Conference (ISECON), Baltimore, Maryland.

Smith, D. H. (1973). *Confucius*. London, UK: Temple Smith.

Thakkar, D. (2011). Social and Cultural Contexts of Chinese Learners: Teaching Strategies for American Educators. *Multicultural Education, 19*(1), 51-54.

Wu, E. (2008). Parental Influence on Children's Talent Development: A Case Study with three Chinese American families. *Journal for the Education of the Gifted, 32*(1), 100-129.

Xu, G. (2014). Philosophy and Methods for China's Vocational Education Curriculum Reforms in the Early Twenty-First Century. *Chinese Education & Society, 47*(5), 57-64.

Zengtao, Z. (2012). EFL Teaching and Reform in China's Tertiary Education. *Journal of Language Teaching & Research, 3*(6), 1098-1104.

Progression of a Data Visualization Assignment

Joni K. Adkins
jadkins@nwmissouri.edu
Mathematics, Computer Science, & Information Systems Department
Northwest Missouri State University
Maryville, MO 64468, USA

Abstract

The growing popularity of data visualization due to increased amounts of data and easier-to-use software tools creates an information literacy skill gap for students. Students in an Information Technology Management graduate course were exposed to data visualization not only through their textbook reading but also through a data visualization assignment. Through a review of current literature and practice, student feedback, and instructor experience, the data visualization assignment has been updated multiple times in an effort to best serve the students' learning needs. This paper provides a brief literature review on why data visualization is growing and why students should learn about it and then outlines the data visualization assignment through each iteration. Lessons learned from student feedback on a student survey and suggestions for future assignments are also included.

Keywords: data visualization, data viz, Tableau, interactive data visualization, story, assignment

1. INTRODUCTION

Data visualization (or data viz) is a broad term referring to both the visual representation of data and the study of the presentation of data in a visual way (Turban, Volonino, & Wood, 2013). Data viz can also be defined as "the presentation of information in graphical or pictorial form, such as dashboards, interactive reports, and interactive presentations" (Brands, 2014, p. 56). Data visualization is becoming more popular as companies and organizations have access to more data and better software tools to handle the data. The popularity and prevalence of data visualization compels information systems instructors to add data visualization instruction and assignments to course work to expose students to this information literacy skill. This paper discusses a data visualization assignment as it has progressed through four semesters.

2. DATA VIZ POPULARITY

"Gartner predicts that analytics will reach 50 percent of potential users by 2014. By 2020, that figure will be 75 percent, and we will be in a world where systems of record, systems of differentiation and systems of innovation are enabling IT, business and individuals to analyze data in a much denser fashion than before" ("Gartner Says Business Analytics," 2013, para. 3). Trends that are helping data visualization growth include visualization software that non-programmers can use, improved aesthetics in today's software, and growth in self-service and mobile applications (Turban et al., 2013). In addition, the existence of cheap data, cloud computing, and availability of software tools such as Hadoop are other forces that feeding big data and data visualization growth ("Visualizations Make Big Data Meaningful," 2014).

Data visualizations can replace cognitive calculations and improve understanding as people are able to see trends and patterns in the data (Heer, Bostock, & Ogievetsky, 2010). Individuals who use data visualization tools state that it would take approximately nine hours longer to detect trends and patterns if they did not use data visualization (SAP News, 2014). The visual forms and patterns allow users to link the pictures to the information and may bring "aha" moments faster than examining rows in a spreadsheet (Brands, 2014). Since working memory is limited, a meaningful data visualization can provide a clear and straightforward way to communicate a message (Evergreen & Metzner, 2013).

Traditional pie and bar charts have been used for years in companies, but now there is a desire for more interesting and interactive displays of data ("Visualizations Make Big Data Meaningful," 2014). Many organizations are going beyond basic Excel functionality for their charts and graphs and using interactive data visualizations where users can interact, filter, display more or less detail, or select certain items for display (Janvrin, Raschke, & Dilla, 2014). In fact, interactive data visualization is experiencing more growth than traditional business intelligence tools with tools like Tableau, QlikTech, and Spotfire ("Gartner Says Business Analytics," 2013).

Another reason for the growth of data visualization is that it can be applied to any field, not just statistics or business (McCandless, 2014). Research on data visualization will show plenty of examples of data visualization used in health care, business, science, government, and many other areas.

3. NEED FOR INSTRUCTION

One of the steps in deploying visualizations is making sure the users have the correct skill set (Polsky, 2013). Kelly (2015) emphasizes that college graduates need skills in data visualization to be effective in today's business world. Womack (2014) agrees that data visualization is now a core information literacy skill. Many of today's college students have not yet been exposed to data visualization and the proper techniques in generating visual displays.

Current data visualization tools allow students to easily create visualizations which may or may not be appropriate for the data. Students should learn to evaluate the various types of visualizations available and justify whether it is a proper representation to use (Womack, 2014). Determining an appropriate data visualization is a challenge for creators (Heer et al., 2010). Creating a data visualization requires the user to determine the questions to ask, identify the correct data, and then select an effective visual display to represent the data (Heer et al., 2010). Data visualization principles include "striving for clarity, avoiding clutter, and emphasizing the most relevant data" (Womack, 2014, p. 15). Students can easily get caught up in making data visualizations that are attractive but might not represent the data correctly. For example, some students use a line graph on data that does not have any logical connection. Instead a bar chart is generally a better choice. In addition, default settings in software programs may overcomplicate the graph by including gridlines, details, extra labels, or distracting colors (Evergreen & Metzner, 2013).

Data visualizations can be very pleasing to the eye, but students should remember that data visualizations are a tool to be used to better understand the data (Womack, 2014). Since most college students have not been exposed to graphic or data visualization principles, adding a component on data visualization can be beneficial to the student and potential employers.

4. ASSIGNMENT PROGRESSION

Information Technology Management is a graduate course for MBA and M.S. Applied Computer Science students. Students in this course are exposed to data visualization in their textbook so it was logical for them to practice the concepts with an assignment. This course is taught online, blended, and in a traditional format. Approximately 350 students take this course each year. The course does not have any pre-requisites so students can take it at any time during their graduate studies. The data viz assignment is approximately 10 percent of their overall grade.

The first time the data visualization assignment was attempted was during a summer blended class. The class meetings were reserved for spreadsheet activities, case presentations, library instruction, and exams so there was not time to include data visualization during a class session. The students were to watch the TED talk by David McCandless titled "The Beauty of Data." This video does an excellent job of showing students the power of data visualization. Then the students were to read the article "A Tour Through the Visualization Zoo" by Jeffrey Heer, Michael Bostock, and Vadim Ogievetsky. The article explains different types of charts to use for different kinds of data. Next the students found a data visualization to share with others. The students then participated in a threaded discussion when they discussed the video, posted the data visualization they found and discussed what type it was, and then suggested how a data visualization could be used with a company they had previously studied in a case assignment. The assignment went okay, but we wanted them to practice creating a data visualization in the next iteration.

The assignment was significantly changed for the fall course offering. The fall course was a 15-week traditional course meeting twice a week. The students had approximately three weeks to work on the visualization assignment. The assignment was done in groups of 4-5 students where one group member located data and installed Tableau desktop on their notebook computer. Tableau software "helps people to see and understand data" ("Tableau Software," 2015). Tableau is a free data visualization program for students. Students can load Excel files into Tableau where they can create the data visualizations. Each student in a group created one chart in Tableau. As a group, they created a story and a dashboard with their Tableau charts. In addition, the student group was to make an infographic using Piktochart, another free tool. While data visualization is a singular view of data, an infographic is a collection of visualizations that tell a story (McCandless, 2014). The student teams then did a presentation in class to display their Tableau charts and Piktochart infographic. Students were surveyed at the end of the class, and they shared that the most frustrating part of the assignment was that the software and files were on one person's computer so that one student seemed to do the majority of the work. Also since the students were responsible for finding their own data, the team member who found the data set tended to have more knowledge and interest in the data set. Most student teams used data sets available from their jobs on campus.

The instructor used the feedback from the fall assignment and made the spring data visualization assignment an individual assignment to remove the barrier of sharing one computer. Tableau was selected as the software, and an infographic was not required. A scoring guide was created where the students typed their responses to the assignment and submitted it as part of the grade. The first due date of the assignment required students to find a data set, clean it up (if necessary), watch at least 5 videos on Tableau and include the links and note which video was most helpful on their sheet, and write three questions they wanted to answer with the data set. The second part of the assignment was to create three charts to answer the three questions. The students had to justify and provide an explanation why they chose the data visualization they did. The students also created a story and a dashboard. The latest version of the assignment sheet is shown in Appendix A.

Instead of class presentations, students met individually with the instructor for a 10-minute demonstration. Interaction is an important part of data visualization (Kosara & Mackinlay, 2013). The demonstration allowed the students to review their story and then the instructor could ask questions so the students could show how they could interact with the data. The student brought their notebook computer with Tableau open and their charts, story, and dashboard to the instructor's office where they sat together and went through the assignment sheet. The downside to interaction is it can interfere with a story (Kosara & Mackinlay, 2013). When the instructor asked a question during the story, sometimes the student would add a filter or make a change that would impact the story. A better technique is to wait for the end of the story to begin interaction (Kosara & Mackinlay, 2013).

At the end of the meeting, each student was asked what the most challenging part of the assignment was. The most common response was finding the data set. The students had been provided a list of web sites where they could get data sets, but they often had to search to find a data set in an Excel format.

The next class offering was the 6-week blended summer class. We made some changes to allow the new data visualization assignment to fit into the course schedule. The day the assignment was initiated, the students watched the TED video in class so they all were introduced to data visualizations. Each instructor provided an Excel data set to each course section so they did not have to find their own data set. The data sets came from data.gov, and students were provided the URL to the data set so they could learn more about the data. Some of the students in the spring course had used the filter feature to make their data visualizations more interactive; therefore, using a filter was added as a requirement for the summer class. The other parts of the assignment remained similar to the spring assignment as there were again two due dates to force the students to install the software, watch videos, and determine their questions in the first week of the assignment. Again students signed up for a 10-minute demonstration with the instructor. At the end of the summer data visualization assignment, a survey was made available to the students so the instructors could see where the students were starting with their data visualization experience and to learn what should be kept and/or changed about the assignment.

5. RESULTS

259 students enrolled in Information Technology Management in summer 2015 participated in the voluntary survey. They were awarded two extra credit points for their participation.

The first question asked about their prior experience with data visualization. Forty-eight percent had no previous experience with data visualization. Approximately 45 percent of the participants had visualization experience with Excel charts and graphs. Other products that students also indicated some experience with were Tableau (11 percent), Weka (9 percent), SAS or R (3 percent), Qlik (2 percent), Business Objects, Cognos, Hyperion, and Microsoft SSRS tool (all less than one percent). Students were asked to rank their prior experience with data visualization tools and the average score was 3.05 on a 7-point scale. Overall, these students had limited or no experience with data visualization.

The participants were asked if watching the TED data visualization video was helpful or not helpful to their understanding of data visualization. Ninety-eight percent indicated that watching the video was helpful. One student commented that the TED video showed creative ways to visualize data, it created enthusiasm in me."
Participants indicated the likelihood of using Tableau again by with 1 being extremely unlikely and 7 extremely likely. The average score was 5.94 on the 7-point scale. Participants were more likely to recommend Tableau to others with an average score of 6.27 on a 7-point scale.

Participants were then asked if they preferred a 10-minute demonstration with the instructor or a class presentation to showcase their data visualization. Sixty-six percent preferred the demonstration while 34 percent would rather give a presentation in front of the class. One participant commented that "the one-on-one session was really helpful in knowing the viewpoint of people when we represent something on Tableau. I learned how to think in the viewer's perspective." Another participant shared "The most rewarding part of assignment is presenting the viz created. That 10 minutes where we presented our visualization is when we had to convince why the visualization suited the data."

The data set was given to the summer class sections so they had to use the data set provided. The participants were asked if they would rather find their own data set. Only 12 percent indicated they would prefer to find their own data set for the assignment. The last two questions were open-ended and allowed participants to write about the rewarding and challenging parts of the assignment. The responses were read and analyzed to find common themes.

The most common challenge was forming the questions to ask about the data as participants indicated "to frame the questions from a large set of data was really challenging." There are several possible reasons for this including the data set is not familiar to the students, and students were required to write the questions before they did the data visualizations. Some wanted to change their questions later after they started working on the data visualizations. Another challenge that participants included was learning Tableau as there were no instructor-provided materials. One participant commented "As I am new to this software, there was steep learning curve at the beginning of the assignment. But after some hours, I got used to it. Now I love it." They were to use web resources from Tableau and YouTube to learn how to use Tableau. There are lots of good learning materials available online. The third top challenge was selecting an appropriate data visualization for the data displayed. The fourth challenge was understanding the data set. Other challenges listed were analyzing the data, cleaning up the data, telling the story, and using filters.

The most mentioned rewarding part of the data visualization assignment was working with Tableau. As indicated previously, students had to learn Tableau on their own, but after learning it, many saw learning the new software as a positive. The second positive was the general comment of learning to visualize data. The third most common rewarding point was learning something new. One student commented that the most rewarding part was "self-learning of the tool, which gave me a confidence to learn any type of tool in the coming future" while another wrote "this assignment gave me confidence that I can work on my own with the help of online information and succeed in any tasks which I have no idea." Other rewarding points of the assignment were the good output, displaying data in different formats, the dashboard, the story, and using filtering. In general, participants seemed to be proud of their progress made in data visualization and in their final Tableau dashboard and story.

6. LESSONS MOVING FORWARD

One lesson learned is that the data visualization assignment should remain as part of the class. Given the limited exposure students have to data visualization prior to the class and the need for students to be familiar with data visualization techniques (Kelly, 2015; Womack, 2014), the data visualization assignment does provide an introduction to the emerging data visualization topic.

The students in the summer class were almost all students in the applied computer science master's program so their career goal is usually software development. This assignment was introduced as one where they would have to learn the software on their own, just as they will have to do throughout their career. Given that a number of participants commented that their confidence in learning new software tools increased with the assignment, there are no plans to make or provide additional tutorials or videos to students. The students should be able to use existing materials to learn about data visualization.

The use of the TED video on data visualization was justified since nearly all students found the video beneficial. Also the decision to change the assignment to a demonstration instead of a class presentation was confirmed. The time commitment for an instructor is generally greater than a class presentation but does give the chance to meet one on one with students and provide immediate feedback on their assignment. Since data visualization is about engaging with the data for increased understanding (Evergreen & Metzner, 2013), having the chance to talk one on one with the student lets them showcase their story and engage with the instructor. While a small percentage of students wanted to find their own data, most were satisfied with having the data set provided to them. Participant feedback verified all of these assignment conditions.

Since forming the questions was the most challenging part of the assignment for many students, further examination is required. One solution could be to have the questions be part of the second part of the assignment so students could essentially change the question after they have created their data visualizations. Another solution would be to spend some time in class reviewing the data and having the students generate multiple questions and then determine which one could be answered with the data. This process could help them develop a better story for the data. A drawback could be that several students would end up with the same questions. A third option would be to have a preliminary assignment with a small data set to give students some practice forming questions. The data sets provided were not related to the course or the information technology industry. Perhaps if the data were related to a student's interest or area of study, he or she would be able to generate better questions.

In the first iteration of this assignment, students were required to read an article that discussed different kinds of data visualizations and when they were appropriate to use. The assignment sheet the students currently fill out requires them to discuss this but they were not required to read any articles about selecting an acceptable data viz. Students could again be required to read about various types of data visualizations. This could help them overcome the challenge of determining the correct data viz.

7. CONCLUSION

The need for better data skills continues as "86 percent of business decision makers say they believe all employees in a company will eventually need to be 'data geeks,' meaning they will require skills to analyze company data and make decisions based on that analysis" (SAP News, 2014, para. 1). Data visualization is a current topic that deserves attention in an information systems class as graduates will be expected to interact with and understand data as a basic element of information literacy (Womack, 2014).

Information systems educators realize that the content and tools in our classroom will constantly change. As a result, the assignments used to teach and assess students must also adapt to meet the changing needs of students and their future employers. The data viz assignment will continue to evolve as new tools are developed and student skill levels increase. Feedback learned from the participants in the summer study will impact the assignment in future semesters. Teaching data visualization in a completely online class will begin in the Fall 2015 term. The Blackboard Collaborate software currently used for group presentations will be used for the student demonstration. The instructor will be able to talk with the student online and the student will be able to share their desktop so they can display their data visualizations.

Educators and students realize that practice helps develop knowledge and skills so this experience with data visualization creation will help develop skill and wisdom in making good visualizations (Womack, 2014). As one participant noted, "Learning new techniques and the usage of Tableau in various ways was a rewarding experience." While the assignment does not attempt to cover all aspects of data visualization, it does provide an introductory experience so the students can begin practicing this information literacy skill.

8. REFERENCES

Brands, K. M. (2014). Data Visualization and Discovery. *Strategic Finance*, *96*(12), 56–57.

Evergreen, S., & Metzner, C. (2013). Design Principles for Data Visualization in Evaluation: Design Principles for Data Visualization. *New Directions for Evaluation*, *2013*(140), 5–20. http://doi.org/10.1002/ev.20071

Gartner Says Business Analytics Will Be Central for Business Reinvention. (2013). Retrieved July 6, 2015, from http://www.gartner.com/newsroom/id/2510815

Heer, J., Bostock, M., & Ogievetsky, V. (2010). A Tour Through the Visualization Zoo. *Communications of the ACM*, *53*(6), 59–67. http://doi.org/10.1145/1743546.1743567

Janvrin, D. J., Raschke, R. L., & Dilla, W. N. (2014). Making sense of complex data using interactive data visualization. *Journal of Accounting Education*, *32*(4), 31–48. http://doi.org/10.1016/j.jaccedu.2014.09.003

Kelly, S. (2015). Teaching Infographics: Visually Communicating Data for the Business World. *Business Education Forum*, *59*(3), 35–37.

Kosara, R., & Mackinlay, J. (2013). Storytelling: The Next Step for Visualization. *Computer*, *46*(5), 44–50. http://doi.org/10.1109/MC.2013.36

McCandless, D. (2014). Who Doesn't Like a Good Data Visualisation? *Creative Review*, *34*(1), 41–44.

Polsky, A. (2013). Data Visualization: 7 Considerations for Visualization Deployment. International Institute for Analytics. Retrieved from http://resources.idgenterprise.com/original/AST-0116272_DataViz_7_considerations.pdf

SAP News. (2014). SAP-Sponsored Survey Finds Business Decision Makers Struggle to Unlock the Power of Big Data. Retrieved July 6, 2015, from http://www.news-sap.com/sap-sponsored-survey-finds-business-decision-makers-struggle-unlock-power-big-data/

Tableau Software: We help people see and understand data. (2015). Retrieved August 20, 2015, from http://mission.tableau.com

Turban, E., Volonino, L., & Wood, G. R. (2013). *Information Technology for Management: Advancing Sustainable, Profitable Business Growth* (9 edition). Hoboken, NJ: Wiley.

Visualizations Make Big Data Meaningful. (2014). *Communications of the ACM*, *57*(6), 19–21. http://doi.org/10.1145/2601074

Womack, R. (2014). Data Visualization and Information Literacy. IASSIS Quarterly, 38(1), 12–17.

Appendix A

Data Viz Assignment – Summer 2015

To get started, download Tableau, choose and watch your training videos, and get familiar with your data set.

Questions	Type your answer in this column. The shaded boxes do not need to be filled in.	Due date	Points
What training videos did you watch? Include the URLs to the videos. These can be from Tableau or from YouTube. You should watch at least 5 training videos. Which one was the most helpful?		5/28	4
What data set did you use? What "cleaning up" or changes did you have to perform?		5/28	4
What questions are you trying to answer/display in your visualizations? Write these as specific questions.		5/28	4
Chart 1: What type of viz did you create? Why did you select the data and the viz that you did?		6/3	4
Chart 2: What type of viz did you create? Why did you select the data and the viz that you did?		6/3	4
Chart 3: What type of viz did you create? Why did you select the data and the viz that you did?		6/3	4
Create your story		6/3	4
Create your dashboard		6/3	4
Demonstration to instructor. Be prepared to talk about your data and your choices and demonstrate your filter(s).		6/3	8
Total points			40

Agile Preparation within a Traditional Project Management Course

Jeffrey P. Landry
jlandry@southalabama.edu

Rachel McDaniel
rachelmcdaniel47@gmail.com

School of Computing
University of South Alabama
Mobile, Alabama 36688

Abstract

Agile software approaches have seen a steady rise over a decade and a half, but agile's place in the information systems (IS) undergraduate curriculum is far from settled. While agile concepts may arguably be taught in multiple places in the IS curriculum, this paper argues for its inclusion in a project management course. This paper builds on work by Schwalbe and the Project Management Institute (PMI) to define a set of topics for undergraduates. The co-authors, a professor and a senior student at a public, four-year university, consulted four sources: an industry partner, the PMI, the Schwalbe textbook, and published literature. The authors created course content, including a glossary of terms, individual and team assignments, and assessment items. Our thesis is that agile can be taught alongside traditional project management topics and broadly across PMBOK® areas. Results from the spring semester indicate that students demonstrated a sufficient level of mastery of outcomes.

Keywords: agile, curriculum, project management, team-based learning

1. INTRODUCTION

The use of agile practices is becoming more and more prevalent. Since the publication of the Agile Manifesto (Beck et al., 2001), agile has gained in popularity. PMI's research has shown that the use of agile has tripled from December 2008 to May 2011 (Schwalbe 2012) and has grown even more since 2011. According to the VersionOne (2014) State of Agile Survey, approximately 88% of respondents are practicing agile in the workplace.

As agile gains ground in industry, it is important to consider its place in the IS curriculum. As it was formulated as a better way for developing software, it makes sense to include agile in courses that cover software development. The IS 2010 model curriculum (Topi, et al., 2010) mentions "agile methods" in the topics list for the IS 2010.6 Systems Analysis & Design course. Programming and project management are two other courses that may incorporate agile methods, although the IS 2010 is silent in this regard. Schwalbe (Schwalbe, 2014, 2012) has incorporated agile into her project management textbook, however, and the Project Management Institute (PMI) has adopted agile concepts in its framework, offering an Agile Certified Practitioner (PMI-ACP®) certification (Project Management Institute, 2011).

Motivated by the values that drove the originators of the Agile Manifesto, namely that agile methods are a better way, the authors set out to define course content and pedagogy to prepare students for an increasing agile world. The lead author is a professor teaching project manager to seniors in the information systems (IS), information technology (IT), and health informatics (HI) majors at a midsize, southern, four-year, accredited, public university. The co-author was a senior IS major who had previously taken the course and was assisting the professor in a locally funded research project. In accordance with their responsibilities and common area of interest, the co-authors limited their focus to the project management course. The research question for the paper is, therefore,

What is a best set of agile concepts and practices appropriate for an IS project management course?

The expected contribution is to provide faculty members teaching PM courses with helpful guidance in putting together an effective agile component.

2. APPROACH

Several early decisions were made on the approach. The first was to not radically redesign the PM course, but to teach agile alongside traditional project management. The authors did not wish to risk being foolish by touting agile as a "silver bullet" (Brooks, 1987), and also recognized that not all situations are suitable for a completely agile approach. The approach enables comparison as well. The second decision was to teach agile throughout the course, and not just as a single topic, as agile provides for many different methods. Eventually, it was decided to use the well-accepted Project Management Body of Knowledge (PMBOK®) areas as a content framework for achieving coverage breadth. A third decision, as a result of the singular focus on the project management course, was to focus broadly on agile *project management*, rather than on agile *software development*, or developing a specific type of product. Our approach, in summary, is principally: 1-agile alongside, 2-agile throughout, and 3-project not product.

We chose topics for each area and created content. Four sets of presentation slides were created and presented:

- An introduction to agile
- Is agile right for my project?
- Agile in industry
- Agile human resource management

We also created a glossary, assignments and assessment items. A glossary of 40 vocabulary terms resulted, with at least one term falling into each of ten PMBOK areas. A ten-item multiple choice quiz was created and given to individuals and teams as part of a team-based pedagogy (Michaelsen, Knight, and Fink, 2004) used in the class. A total of 25 multiple choice items were created overall, with others used on the midterm and final exams. Three individual assignments were given:

- Financial evaluation methods problems (same as for traditional)
- An online discussion forum on an *Is agile right for my project?* Case
- A soft skills writing assignment on *Am I ready for agile?*

The latter assignment requires students to take an emotional intelligence self-assessment "quiz" and write about their results. Student teams took part in an active learning assignment on planning poker, where individuals iteratively estimated task times using a Delphi-like technique. The final exam had an essay question on agile soft skills, and a burndown chart problem. These assignments and items were given in addition to the assignments, items, and activities already in place for traditional project management practices.

3. AGILE ACROSS THE PMBOK AREAS

For each of the ten PMBOK areas, we have defined one or more key topics for coverage in the project management course. In selecting these key topics, the key criteria were to identify something in every area and to select the more important topics within each area. We considered what already was covered in the Schwalbe text, as well as the emphasis of project over product. As for Schwalbe's coverage, she provides an extensive example case in an early chapter, done in both traditional and agile approaches. Many of the terms and concepts we used as agile were present in her text as well. See Table 1 that follows for a list of topics by PMBOK area. What was taught in the course was actually more than what is in the list, but the list in Table 1 represents a post hoc reflection on what is most important.

Integration

Project Integration Management is the area that incorporates and coordinates multiple areas at once. For Agile, it is the core values and principles that encapsulate all practices. Thus, the Agile Manifesto (Beck et al., 2001) is the critical coverage area. In the manifesto, which can be accessed at agilemanifesto.org, the signatories assert that a better way of developing software is to value the following:

Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

Agile practices may change, but the practices should remain consistent with core values.

We first introduce agile (Rajamanickam, 2005; Conforto and Amaral, 2010) with the discussion of the manifesto, and with a contrast between traditional and agile project management (Fernandez & Fernandez, 2008; Lipika & Sanjeev, 2013), and, finally a discussion of conditions that are right for agile to be used (Augustine, Payne, Sencindiver & Woodcock, 2005; Nerur, Mahapatra & Mangalaraj, 2005). Agile is right for a project when:

1. Project exhibits high variability in requirements
2. Team members have a high knowledge base and can learn quickly
3. Team members are willing to adapt to change
4. Resources for project are easily accessible
5. Customer is highly involved and in close proximity
6. Value of the product to be delivered is very important to the customer
7. Manager is comfortable with a facilitator role

The *planning game* of eXtreme programming (Lindstrom and Jeffries, 2004), one of the popular agile approaches, calls for the customer-involved identification and prioritization of features, broken down into work tasks, then completed in a test-driven manner, iteratively throughout the project. This agile approach to planning is at the heart of agile project management and integrates the areas of scope, time, quality, and stakeholders, and more.

Scope
Project Scope Management covers all of the work needed to complete the project. Agile scope management revolves around the iterative identification of requirements, or features, called user *stories*, expressed in the terms the user can understand. The collection of prioritized stories and the work into which the stories are broken is called the *backlog*. The management of agile scope is iterative and customer-involved, and addressed by project integration management processes described above. In contrast to traditional project management, in which scope is fairly rigid, scope is highly variable in agile projects. Agile practitioners prefer responding to change over following a plan. Scope change is a part of every project iteration, called sprints in Scrum (Shojaee, 2012), one of the two most popular agile approaches.

Time
It is difficult to define a singularly important agile concept in the area of Project Time Management. Perhaps it is the concept of *timeboxing*. Project schedules in agile are timeboxed, or fixed, into typically two to four week intervals called *sprints*. Rather than estimating how long work is going to take and trying to meet that estimate on a task-by-task basis, an agile project team breaks down and estimates stories using a technique such as *planning poker*, a Delphi like method. The team then picks the number of stories that can be completed in a sprint. The idea is to complete a cycle of activities in a sprint, including testing and user acceptance, allowing for variations in scope rather than time. A burndown chart is used to show progress and estimate project or sprint completion. With the *Kanban* approach, estimates are not even made. Instead, tasks are written on sticky notes and placed on a white board in one of three columns: to do, doing, and done, with notes moved from left to right as tasks change state.

PMBOK area	Key Agile Topics
Integration	Agile manifesto values & planning game
Scope	User stories/backlog
Time	Timeboxing, sprints, planning poker, burndown chart, Kanban board
Cost	Financial evaluation methods (NPV, ROI)
Quality	Acceptance testing, definition of done, escaped defects
Human Resources	Emotional intelligence, Scrum Team
Communication	Co-location, Daily Scrum, empathic
Risk	Progressive elaboration, risk-adjusted backlog
Procurement	Agile contracting methods
Stakeholder	Scrum Master, Product Owner, servant leadership

Table 1 - Agile topics by PMBOK area

It is interesting to make a three-way comparison between traditional Gantt charts to burndown charts to Kanban boards. Gantt charts provide for the most complexity with relationship among tasks that are all estimated. Burndown charts show task estimates, but no task relationships.

Kanban displays task status without relationships nor estimates.

Cost
Project Cost Management deals with the financial resources of projects. All students should understand the interrelationships between project scope, cost, and time. However, it is interesting that scope is the area that varies in agile projects, while cost and time are relatively fixed. Cost concepts emphasized in the PMI-ACP are the traditional financial evaluation methods of net present value (NPV) and return on investment (ROI).

Quality
Project Quality Management for agile projects in particular is concerned with the need-satisfying aspect of a project's unique purpose. Essential to project quality management is satisfying key stakeholder needs or expectations. *User acceptance testing* involves independent testing by users of working software at the end of each iteration. Agile projects need an agreed upon *definition of done* that includes a quality criterion. *Escaped defects* is a measure of agile software quality. The goal is zero escaped defects, meaning that all defects are detected and corrected by testing during development.

Human Resource
Project Human Resource Management is the area that seeks balance between the needs of people and the needs of the project. The *Scrum Team* is the primary human resource needed to complete an agile project. A project manager, or Scrum Master, needs to develop soft skills, such as *emotional intelligence* to effectively work with other people in the project. Emotional intelligence the ability to identify, use, understand, and manage feelings in positive ways to relieve stress, communicate effectively, empathize with others, overcome challenges, and defuse conflict (managedagile.com).

Communication
Project Communication Management covers all activities related to project information. A key idea here is to keep project stakeholders informed. Until recently, project stakeholder management was covered in this area but now has come the tenth and newest PMBOK area. Now, the emphasis is not only to keep them informed but engaged. Key among stakeholders are users. In an agile project, they are engaged by their *co-location* with the project team and through *empathic* or active listening. Another critical stakeholder-related communication in agile projects occurs among team members in daily standup meetings. In Scrum, the *Daily Scrum* communicates three pieces of information—what was recently completed, what is to be done today, and what obstacles are being faced.

Risk
Project Risk Management deals with addressing areas of positive or negative uncertainty that can affect a project. Schwalbe identifies *progressive elaboration* as one of the attributes of a project. Progressive elaboration is that property that concerns how uncertainty is reduced as a project becomes clearer in more detail as it proceeds forward. Furthermore, effective risk management can help reduce uncertainty faster and more effectively. *Risk-adjusted backlog* is an agile approach to prioritizing user stories (Senevirathne, 2014) that is identified as a risk management topic in the Tools and Techniques section of the PMI-ACP exam. It adopts the principle of addressing riskiest items first.

Procurement
Project Procurement Management concerns the use of project resources outside the organization. Usually, contracts are used to enforce agreements. Agile projects are highly non-traditional. When establishing contracts for agile development, non-traditional contracts are needed or else the project will be in danger of failing to reap the benefits of agile approaches (Arbogast, Larman, & Vodde, 2012). For example, agile contracts should codify that scope changes during a project be handled in a way that corresponds to agile's value of responding to change. *Agile contracting methods* is identified in the PMI-ACP as a knowledge and skill, along with vendor management, as the only two procurement topics.

Stakeholder
Project Stakeholder Management is the newest PMBOK area, being separated from Communications. See *Communication* above. In agile Scrum projects, there is no project manager in the traditional sense (Hunton 2012). Instead there is a *Scrum Master* who facilitates the Daily Scrum, and a *Product Owner*, who ensures business value by overseeing the scope prioritization process. *Servant leadership* is listed as a concept in the soft skills negotiation section of the PMI-ACP exam. Stakeholders are the beneficiaries when project managers serve by putting others first.

4. STUDENT LEARNING OUTCOMES

During this year's first delivery of the project management course that included agile concepts, and afterwards, we developed and refined a set of course objects for what we are arguing is a best set of agile project management concepts.

1. Evaluate the suitability of agile methods for use in a given project and organization context
2. Analyze project proposals using multiple techniques
3. Compare and contrast traditional versus agile project management
4. Demonstrate an awareness of agile project management basic terminology and concepts across multiple PMBOK areas.
5. Apply agile PM principles and techniques for managing in multiple PMBOK areas
6. Discuss the soft skills and abilities of project managers
7. Complete team-based work applying the principles and tools of project management

5. ASSESSING STUDENT PERFORMANCE

As with other topics in the course, student performance on agile topics varied. Towards the end of the course, students were given a Readiness Assurance Test (RAT) on agile project management. A RAT is a type of quiz given in the Team-Based Learning (TBL) pedagogy (Michaelsen et al., 2004). First, individuals are quizzed (iRAT) typically with ten multiple choice questions on a topic area worth four points each. The same quiz is then taken by the permanent teams (tRAT), using a scratch-off-the-answer card called an IF-AT (Immediate Feedback Assessment Technique).

RAT #4 - Agile (max score=40)					
	Team 1	Team 2	Team 3	Team 4	Team 5
iRATs	34 32 30 24 19	36 33 26 25 24	32 31 30 30 28 22	29 28 24 20	36 36 34 32 28
tRAT	38	36	36	36	38

Table 2 - Agile RAT results

On the iRAT, 17 of 25 students received a passing score of 70% (28 of 40 points). The mean was 73%. The tRAT scores were all at 96% or above. See Table 2. These RAT scores were consistent with how students typically perform on iRATs and tRATs. The grand means for iRATs (n=4) in that semester was 72% and the grand mean for tRATs was 94%. These results indicate that students mastered the agile PM material similarly to other course content.

However, performance on the midterm and final exams was lower than historical averages in the project management course. The midterm average was 68% compared to 78% over the previous three semesters. The final exam average was 71% compared to 80% historically. The students performed similarly on both traditional and agile PM content, and with the agile PM content making up less than 20% of exam content. We are uncertain as to why exam performance trended lower during a semester when RAT performance remained stable. Could the additional agile content have made the course too content heavy? We believe not. As part of the review for the final exam, the students were given a surprise, review quiz—a comprehensive RAT consisting of all questions from prior RATs. The overall performance, a mean score of 76%, was only slightly above the 72% grand mean of the original iRATs, and far below the 94% tRAT performance. Because students had collaborated and were exposed to correct answers, their performance on the re-take would have been better, we thought. One Team-Based Learning instructor (Goodson, 2004) reported that her surprise RAT retakes usually average 80%+. Due to the somewhat low recall, and below average performance on exams, more review and reflection is needed during the semester.

6. CONCLUSIONS

In addressing the research question on identifying the best set of agile concepts and practices appropriate for an IS project management course, we surmised that these concepts and practices could be taught alongside traditional project management topics, that the these topics could fit broadly across project management knowledge areas, and that these topics should emphasize project over product knowledge.

Agile Alongside

While adding agile content throughout the course, we continued to teach traditional approaches, such as the critical path method, while adding agile topics like the burndown chart on the same knowledge area. It is important to point out, however, that we do cover the entire Schwalbe text, and in each knowledge area, we did not try to juxtapose both a traditional and an agile concept. We simply added agile topics. The issue with adding agile topics is that the course could become topic-heavy. Students in our class were able to master agile concepts similarly to other topics, given our results in the RAT. But, student performance on the midterm and final exams was lower than historical averages.

Agile Across

We were easily able to find important agile topics in each knowledge area. All topics came from either the Scwhalbe text, the PMI-ACP exam content guide, or a literature source. The toughest area to find something was procurement, but we did find an important concept (agile contracts) that received mention in the PMI-ACP exam content guide and for which there was literature.

Project Not Product

The topics we chose were project management topics. We did not have to resort to teaching non-project management topics like programming. However, in the case of the planning poker estimation exercise, we realized that students in this case were not expert enough to be able to make confident estimates for (programming) tasks, given the lack of information in the case. In the future, we might stick to the burndown chart and Kanban exercises, or tweak the planning poker exercise to avoid this problem.

7. RECOMMENDATIONS

We make the following recommendations to faculty members considering adding agile PM coverage in their project management course. First, choose at least one learning outcome related to agile PM for focusing your effort. We suggest that the lowest level outcome would be at the awareness level, and that this one would be outcome 4—demonstrate an awareness of agile project management basic terminology and concepts across multiple PMBOK areas. Second, we recommend that you emphasize agile project management concepts across multiple PMBOK areas, and without dropping traditional PM content. Third, we recommend that you assess agile PM so that you can isolate student mastery independent of the rest of the content, so that your intervention can be evaluated. Fourth, we recommend review of material prior to comprehensive testing. Fifth, we recommend additional literature review for discovery of concepts, methods, and approaches to teaching agile PM that may be informative but fell outside of the reach of this study.

8. FUTURE WORK

Our future work begins with getting the learning outcomes right. We believe we are close, now. What's important is that students have some awareness and appreciation of agile so that they can converse intelligently with other professionals, i.e. in a job interview, and are prepared to hit the ground running when thrust into an agile environment. So, a set of low-level outcomes that reflect fundamentals mixed in with some application is warranted. The compare and contrast outcome may be the most important one, not so much to differentiate approaches, but to be able to evaluate effectiveness. It is important to educate students so that they may innovate in order to improve.

Once outcomes are revised, then the task is to adjust content accordingly. We will remove any content not necessary to make sure the course is not becoming content-heavy. We will then adjust assessments accordingly, so that each outcome is effectively assessed. An effective set of assessments can then be used to “certify” that students are agile-ready. We will also look at midterm and final exam results, making sure students are performing at expected levels.

9. ACKNOWLEDGEMENTS

The authors wish to acknowledge Mr. Matt Hughes of the University of South Alabama School of Computing's Industry Advisory Board for his assistance in providing valuable insights on soft skills, Scrum methods, and job interviewing for agile. The authors would also like to acknowledge the support of the School of Computing's Computing Undergraduate Research Experience (CURE) program which funded this undergraduate student research project.

10. REFERENCES

Arbogast, T., Larman, C., & Vodde, B. (2012). Agile Contracts. Retrieved June 13, 2015 from http://www.agilecontracts.org/.

Augustine, S., Payne, B., & Sencindiver, F., & Woodcock, S. (2005). Agile Project Management: Steering from the Edges. *Communications of The ACM*, 48(12), 85-89.

Beck, K. et al. (2001). Agile Manifesto for Software Development. Retrieved June 13, 2015 from http://agilemanifesto.org/.

Brooks, F. (1987). No Silver Bullet—Essence and Accidents of Software Engineering. *Computer* 20 (4), 10-19.

Conforto, E. C., & Amaral, D. C. (2010). Evaluating an agile method for planning and controlling innovative projects. *Project Management Journal*, 41(2), 73-80. doi:10.1002/pmj.20089

Fernandez, D. J., & Fernandez, J. D. (2008). Agile Project Management—Agilism Versus Traditional Approaches. *Journal Of Computer Information Systems*, 49(2), 10-17.

Goodson, P. (2004). Working With Nontradtional and Underprepared Students in Health Education. In L. Michaelsen et al (Eds.), Team-Based Learning: A Transformative Use of Small Groups in College Teaching, VA: Stylus Publishing LLC.

Hunton, Steve (2012). A Scrum Master Is Not a Project Manager by Another Name. Retrieved September 18, 2015 from https://www.scrumalliance.org/community/articles/2012/august/a-scrum-master-is-not-a-project-manager-by-another.

Lindstrom, L., & Jeffries, R. (2004). Extreme Programming and Agile Software Development Methodologies. *Information Systems Management*, 41-52.

Lipika, B., & Sanjeev, T. (2013). Introducing Agile into a Non Agile Project: Analysis of Agile Methodology with its Issues and Challenges. *International Journal of Advanced Research In Computer Science*, (02), 305.

Michaelsen, L. K., Knight, A. B., and Fink, L. D. (2004). Team-Based Learning: A Transformative Use of Small Groups in College Teaching, Stylus Publishing, LLC, Sterling, VA.

Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of Migrating to Agile Methodologies. Communications Of The ACM,48(5), 73-78.

Project Management Institute (2011). PMI Agile Certified Practitioner Examination Content Outline, Retrieved March 3, 2015 from http://www.pmi.org/Certification/~/media/Files/PDF/Agile/PMI_Agile_Certification_Content_Outline.ashx.

Rajamanickam, D. (2005). Successful Project Management Using Agile Methodology. Journal Of The Quality Assurance Institute,19(3), 15-18.

Schwalbe, K. (2014). *Information Technology Project Management*, Seventh Edition, Cengage Learning, Boston.

Schwalbe, K. (2012). Managing a Project Using an Agile Approach and the PMBOK® Guide, In The Proceedings of the Information Systems Education Conference 2012, v 29 (New Orleans): §1985. ISSN: 2167-1435.

Topi, H., Valacich, J., Wright, R., Kaiser, K., Nunamaker, Jr., J., Sipior, J., and de Vreede, G. (2010). IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems. *Communications of the Association for Information Systems*, 26(18).

VersionOne Inc. (2014). 8th Annual State of Agile Survey, Retrieved March 26, 2015 from http://www.versionone.com/pdf/2013-state-of-agile-survey.pdf.

Senevirathne, Akalanka (2014). Risk management in agile projects. *LinkedIn | Pulse*. Retrieved June 13, 2015 from https://www.linkedin.com/pulse/20140618100310-89184031-risk-management-in-agile-projects.

Shojaee, H. (2012). Scrum in 10 Minutes. Retrieved June 13, 2015 from https://www.youtube.com/watch?v=XU0llRltyFM

Editor's Note:

This paper was selected for inclusion in the journal as a EDSIGCon 2015 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2015.

Building I.S. Professionals through a Real-World Client Project in a Database Application Development Course

RJ Podeschi
rpodeschi@millikin.edu
Tabor School of Business
Millikin University
Decatur, IL 62522

Abstract

Information systems curricula are increasingly using active learning methodologies to help students learn *through* technology rather than just *about* technology. While one way to achieve this is through the assignment of semester-long projects, previous research suggests that real-world projects provide more meaningful experiences and prepare expected graduates for careers that will rely on both their technical and professional skills. Additionally, providing opportunities for both competition and collaboration spur the motivation of students while enabling them to practice the necessary professional skills employers are seeking. This paper reports on a database application development course, taught for the past four years, where the instructor has partnered with a different community business or nonprofit organization in need of an information system to convert existing spreadsheet data into a relational database for more accurate data entry and improved reporting. Student teams engage in both competition and collaboration through system development phases to deliver a database solution to an authentic client using Microsoft Access. As a result, students develop both technical and professional skills through this client project experience where ultimately, the client evaluates the students' performance.

Keywords: database, real-world, collaboration, competition, experiential learning, Microsoft Access

1. INTRODUCTION

Higher education institutions are evolving to create more relevant, meaningful experiences for its students through the use of real-world projects in the curriculum. The days of "chalk and talk" and "sage on the stage" are slowly being replaced by teaching methods that involve active and experiential learning by students. Incorporating real-world projects into the information systems curriculum is not unfamiliar territory and is common to help bridge the gap between theory and practice. Students who major in technical fields need to learn not only the concepts and techniques, but also need to gain real-world experience before joining the workforce (Chuang & Chen, 2013). While information systems curricula have been successful in preparing students with technical ability, a 2014 study by the Society for Human Resource Management found that the top four applied skill gaps in technical occupations were critical thinking/problem solving (39%), professionalism/work ethic (34%), leadership (30%), and written communication (25%) (2014). In order to better prepare students for the technical and the professional, a real-world client project was used within the context of a database application development course for upper-level information systems (I.S.) students. Partnerships between the business world and higher education have the potential to provide numerous opportunities (Abbassi & King, 2007). For the organization, it provides fresh perspectives from both faculty and students in addition to a deliverable that increases the value of the organization. For the higher education institution, students are exposed to practical, authentic situations prior to graduation. Additionally, the institution benefits from increased exposure and standing in the community.

Since 2012, a faculty member from the I.S. department within the business school contacted community non-profit organizations and small businesses. Through these relationships, relevant business needs were translated to an opportunity to develop a database information system for the organization. To date, the organizations served have included a domestic violence and community outreach non-profit, an early childhood education center, a private law practice, and the local homeless continuum of care consortia. Through this course, systems that manage volunteer statistics for state reporting requirements, donor engagement, debt collections, and homeless reporting for the Department of Housing and Urban Development, have all been developed and implemented. At the beginning of the semester, the class begins with requirements gathering and progresses through stages of conceptual modeling, physical design, testing, feedback, and implementation, which occurs after the course is complete. The course culminates with students presenting their database application, built in Microsoft Access, to the client for additional feedback and acceptance.

This concept of integrating theory and practice into the classroom, at Millikin University in Decatur, Illinois, is coined as Performance Learning. As defined by the institution, it is the opportunity for students to experience real risk and reward while having their work evaluated by a third-party stakeholder (Figure 1). The third-party stakeholder, or client, has measurable weight in not only evaluating/grading the student deliverables, but in the use of the application developed. Not only are students engaged in practicing their discipline, reflection is intentionally built in during and after the experience.

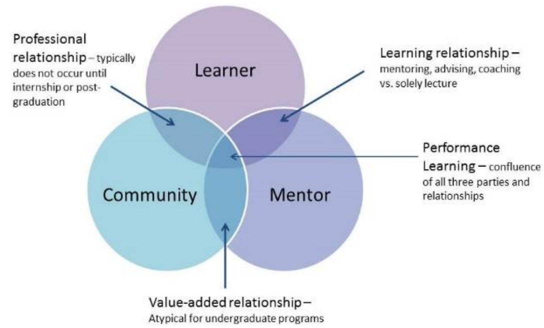


Figure 1.

This paper first reviews previous research related to real-world project use in the classroom and its relationship to higher-order thinking and problem solving that supports the institutional definition of Performance Learning. A detailed account of the course design is outlined and the paper concludes with summative results from student and client feedback over the past four years and its relationship to the practicing of both technical and non-technical skills. This work is important to the discipline in demonstrating that the experience of working for a client with true business needs and goals, where risk and reward are present, provides for increased student engagement, satisfaction, and deeper learning of course content.

2. REVIEW OF LITERATURE

A contemporary issue in I.S. education is how best to incorporate active learning in the classroom to better prepare students for careers following graduation. Student are able to gain real world experience through internships and faculty-directed research projects, but this typically only affects a small number of students. In order to reach a broader audience, curricula have slowly shifted from more lecture-based learning to a style that engages students in a more applied fashion through project-based work, and the I.S. discipline lends itself well to this method. Schuldt (1991) defined these as "simulated projects" and "real world" projects (p. 35). Some instructors create projects that simulate business operations and students are required to perform analysis, design, and creation of an information system. Others have engaged with a community business or organization that have an actual problem that needs solved with the creation of an information system. These are typically non-profit organizations without the experience or expertise to create a database information system (Schuldt, 1991). Others have partnered with local chambers of commerce and used service learning models in real world information systems projects (Chuang & Chen, 2013). Previous research has shown that students prefer and benefit from real-world projects with authentic clients over simulated projects (Connolly & Begg, 2006).

Through the use real-world projects in the classroom, students gain experience in actual I.T. work before graduation and are able to apply the classroom technical concepts. This helps students gain a more realistic understanding of information systems and solve real I.T. issues (Abbassi & King, 2007). Given that the pace of technology advancement continues to increase, "it is important that educators link the classroom learning to the practice in real-world settings where the classroom models can be tested; and the problem solving and critical thinking skills can be practiced (Chuang & Chen, 2013). Applying constructivist learning theories are well suited for I.S. education. In constructivism, the learner builds on his and others' prior knowledge, belief, and actions. Since technological knowledge is created rather than discovered, learning can happen "naturally" through manipulation (e.g. trial and error) (Connolly & Begg, 2006; Tétard & Patokorpi, 2005). Real-world projects allow students to solve problems in a non-prescriptive context. The constructivist approach to project-based learning in I.S. has yielded affirming results that both domain-specific and social skills were the most valuable throughout the course (Tynjälä, Pirhonen, Vartianen, & Helle, 2009).

While other I.S. educators have proved real-world projects effective, teams of students can benefit from both competitive and collaborative environments. In collaborative learning environments, students assist each other in learning the course material while developing oral and written communication skills, and provide the opportunity to improve their leadership skills (Dietrich & Urban, 1996). Injecting competition, as is the case in the data modeling phase of this real-world project, increased productivity, decreased inefficiency, and motivated students to find the best solution. Not only did students understand the "value of collaboration that is required for effective team performance and true problem solving" (Desai, Tippins, & Arbaugh, 2014, p. 260), but were highly motivated when faced with this moderately competitive element.

Employers are not only seeking graduates with the technical acumen to help the organization, but employers are seeking graduates with a broader set of soft skills. According to a survey conducted from August through early October 2014, by the National Association of Colleges and Employers (NACE), the skills most sought after are teamwork, and ability to make decisions and solve problems. The next most important skill was the ability to communicate verbally with people inside and outside the organization (Adams, 2014). The top 10 skills from the NACE survey can be found in Table 1, in order of importance. Ultimately, providing students with opportunities to practice these sought after skills in real-world environments better prepares them for the workforce.

Top 10 Skills Employers Seek
1. Ability to work in a team structure
2. Ability to make decisions and solve problems (tie)
3. Ability to communicate verbally with people inside and outside the organization
4. Ability to plan, organize, and prioritize work
5. Ability to obtain and process information
6. Ability to analyze quantitative data
7. Technical knowledge related to the job
8. Proficiency with computer software programs
9. Ability to create and/or edit written reports
10. Ability to sell and influence others

Table 3.

Therefore, based on the use of real-world projects in an I.S. course, can technical and professional skills be built simultaneously through competitive and collaborative learning?

3. COURSE DESIGN

The course, database application development, is required for the I.S. major housed within the business school. Students in the I.S. program are grounded in the theoretical areas of programming, system analysis/design, relational databases, and networks while learning hands-on skills in both business and technology that prepare them for managing applications, data, networks, and systems in a wide variety of organizations. This course introduces concepts of relational database theory, data modeling, normalization, and database design principles while building technical skills such as: structured query language (SQL), transaction management, security, and database administration. This course provides students with hands-on experience in translating conceptual data models to physical design through Microsoft Access, MySQL and Oracle database software packages.

Students in the course are typically juniors or seniors who have already had at least one programming course as well as an information technology infrastructure course.

While students are engaged in learning the course content and practicing their technical skills through specific lab assignments, teams of students are immersed in building a database application centered on a specific client's needs to solve a real business problem. Students are placed into teams of 3 or 4 and are determined by students completing a self-assessment of both their technical and interpersonal skills. The instructor uses this information to weight the teams fairly given individuals' strengths and weaknesses. On average, the course enrollment is between 9 and 12 students. The client project is divided into stages of: data modeling, physical database design and report development, user interface, testing & documentation, and presentation & acceptance. This traditional development cycle allows for student teams to present multiple times to the client throughout the semester. As a result, the client feedback becomes the anchor throughout the entire project. The final product at the end of the semester is then implemented and maintained by a paid student intern from the course during the following semester. Students apply for the paid internship towards the end of the fall semester and go through an interview process with both the instructor and the client. A visual of the course design can be found below in Figure 2.

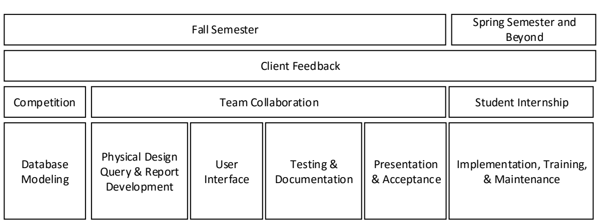


Figure 2.

Initially, the instructor and the students meet with the client at their place of business during the second week of class. Meeting onsite allows for students to tour the facility, understand the role of the organization, and see the larger purpose of their work. During this site visit, students meet the individuals with whom they'll be working. This typically includes a front-line person who currently manages information manually or through a spreadsheet application. Additionally, a supervisor or director is included to help guide the overall strategy of the project. This initial meeting is also the opportunity for the client to explain their current information system, its problems and inefficiencies, and what their vision is for a new information system. Through this process, students are able to understand the existing business process, data elements, and business rules. After the initial client meeting, designated liaisons from each team maintain contact with the client through phone and email to ask additional questions and seek clarification. Teams then work independently to prepare a problem statement that is used to guide the business rules for developing a conceptual data model. The problem statement also serves as the scope of work for the project that is mutually agreed upon by the client and the instructor.

A unique element of this course is the incorporation of competition between the teams during the conceptual data model phase of the project. During this phase, each team is tasked with developing their own conceptual and entity-relationship data model using Microsoft Visio based on their approved problem statement that outlines the business rules and data requirements for the client. Each team presents their data model to the instructor and to the client. Students are instructed to "teach" their data model in the context of their problem statement to the client and instructor. This approach helps to reinforce the fundamentals of data modeling and also educates the client on the fundamental structure of their database information system. After the teams present, the instructor meets with the client to receive feedback and assess the quality of each data model. The client and instructor collectively determine a "best data model" award. With feedback and suggested changes, the project moves forward using the "best data model" as the only data model used for the remainder of the project.

Following the data modeling phase, teams are tasked with implementing the physical data model into Microsoft Access. While there are other DBMS products that are more robust than Microsoft Access, the needs of the clients typically do not exceed the limitations of Microsoft's desktop-based database software package. Microsoft Access is the next evolution in data management from a spreadsheet application, offers a wide range of capabilities, and allows for a rapid application development cycle (Chung, n.d.). In addition, cost is usually a concern when discussing the software environment with non-profit organizations and small businesses. Microsoft Access is a low-cost software product (approximately $110 per license as of January,

2016) in comparison to larger platforms such as Microsoft SQL Server or Oracle, which require a server infrastructure. Based on the clients that are typically selected for this project, Microsoft Access elevates their information system to the next level, and as Chung asserts (n.d.), the "vast majority of database solutions are simple" and Microsoft's desktop application provides a rapid application development (RAD) environment to improve business processes.

From this point forward, teams are allowed and encouraged to collaborate with each other through the report and user interface design phases, as well as testing and documenting. Through these phases, report and user interface deliverables are divided across the teams to complete and incorporate into the final product. Using this approach was preferred over having each team complete their own version of the database application, as there would be duplication of effort. This approach was also preferred to having each team responsible for a different phase as students would not be able to practice their skills in all of the areas of data modeling, SQL, and interface design. However, students did cite difficulty in combining work into one Microsoft Access file despite attempts at various version control systems. As part of the final deliverable, the client receives a print and electronic copy of end-user and technical documentation. Typically, a member of each team collaborates to combine, review, and standardize the documentation. At the end of each of these development phases, students again present their work in a professional setting to the client for formal written and verbal feedback. The final presentation is a collaborative effort between all teams to showcase the final version of the database application to the client in addition to outside evaluators from the university and technology community. Following the presentation, students complete a team and self-evaluation that is used for both reflection and evaluation of their work. Per Kolb's definition of experiential learning, students were provided a concrete experience (real-world client project), abstract conceptualization (data modeling), active experimentation (application development), and reflection (self-evaluation) (1984).

As Abbassi and King noted, "real-life business projects are not automatically declared complete at the end of the semester" (p. 341, 2007). Following the final presentation, the client invites students from the class to apply for a paid internship, supervised by the client and the instructor, the following semester to resolve known issues as well as lead implementation and training efforts for the client. In the end, students have built a technology solution from conception to implementation and community organizations have benefited from the collaboration.

5. RESULTS

After students have delivered their final presentation, the client is asked to complete an evaluation of the students' work. The client is asked questions about what was done best, what needs improvement, and if the organization benefited from the partnership. Over the four years the course has been offered in this format, each client specifically commented on the students' ability to listen to their business needs, ask appropriate questions, and carefully seek create solutions to solve their problem with user-friendly applications. One client representative said this about the students' work:

> "The entire group listened to our needs and adapted the model to meet those needs… I was impressed with the attitude and professionalism shown by each of the students. I always felt like they were eager to work on this project and that it was important to them."

Clients' comments related to improvements were mostly application specific and related to design of the user interface. One client commented that the students relied on the end of the course and the impending intern as a crutch for unresolved issues. All clients expressed resounding support for the partnership and were eager to pursue a partnership with a class again when an opportunity arose.

Student self-evaluations were analyzed qualitatively for specific mention of skills practiced in the areas of database, collaboration, and professional communication. Individual student self-evaluations were required as part of the project. Students were asked to reflect on their experience, and describe how they contributed to the overall success of the project and what skills they applied throughout the semester. Although 45 students have taken the course over the past four years, only the last 3 years of self-evaluations were analyzed (36 students) as the first year of the course used a self-evaluation instrument that did not address these skills. Students reported specifically practicing and building database skills (81%), collaboration (81%), and professional communication (64%). Although this is a small sample size due to the enrollment and size of the program, it represents a compelling case that both technical and professional skills are being built as a result of this client project methodology.

6. DISCUSSION AND CONCLUSIONS

The class is successful, in part, due to the relationship between the university, faculty, and the client. Managing the relationship can be time consuming for the instructor and students, but is paramount in stewarding the project from beginning to end. As has been identified in previous work, one major challenge is working with users who can clearly define the problem. (Schuldt, 1991). As a result, managing the scope or changing definitions of the scope have occurred. Better problem definitions have come from users with more technical experience.

To date, there have not been any failed implementations of the applications built by students, but it remains a real risk for students and the faculty. It is important to select clients carefully, understanding the scope and complexity of their needs far in advance of the beginning of the semester. Serious conversations need to take place with the client so that they understand the timeline for development and implementation, which is likely to be longer than that of a full-time and full-service consulting firm. The client also needs to have a realistic expectation of the skill level of the students. Having students understand the meaning and importance of their work is equally important in driving their motivation to be successful in delivering the final product.

However, the challenges in integrating a real-world project into the classroom are not unlike the challenges of building an information system in practice as a professional. Additional time should be allocated by the instructor to maintain contact with the client and to work outside of normal class hours assisting student teams to solve unforeseen issues. One ongoing concern remains for the integration of real-world projects across the I.S. curriculum. Students enrolled in multiple I.S. courses that contain real-world projects may be too time intensive for some students.

Because student projects are in production use at client sites, ongoing maintenance beyond the initial student internship is a challenge that is being overcome. Work is in progress to launch a student-run consulting venture to maintain software, manage client relationships, technical documentation, and knowledge transfer as students graduate. These steps will help to ensure the sustainability of these client projects.

Ultimately, students are confronted with an array of conditions and variables in a real-world project, whereas a simulated project insulates them from uncertainty, conflict, and change. A real-world project places students in situations where real risk is involved, not unlike the professional arena where they will soon be. Real-world projects take the focus off the grade and the course, and instead, place the emphasis on performing their craft as I.S. professionals, as they will be upon starting their first job. The results of this research support that this experience provides students with the opportunity to complement their technical acumen with employer-desired “soft” skills such as team collaboration and professional communication. In the future, the course will continue to evolve as new projects are completed for clients in the community. Further research is necessary to assess the impact the course has made after graduation and how this course has played a part in their development as I.S. professionals.

7. REFERENCES

Abbassi, B. & King, R. (2007). The Development of a Teaching Strategy for Implementing a Real-World Business Project into Database Courses. *Journal of Information Systems Education*, 18(3), 337-343.

Adams, S. (2014). The 10 Skills Employers Most Want in 2015 Graduates. *Forbes*. Retrieved from http://www.forbes.com/sites/susanadams/2014/11/12/the-10-skills-employers-most-want-in-2015-graduates/.

Chuang, K. & Chen, K. (2013). Designing Service Learning Project in Systems Analysis and Design Course. *Academy of Educational Leadership Journal*, 17(2), 47-60.

Chung, L. (n.d.). “Microsoft Access within an Organization’s Overall Database Strategy.” Retrieved from http://fmsinc.com/MicrosoftAccess/Strategy/index.asp.

Connolly, T. & Begg, C. (2006). A Constructivist-Based Approach to Teaching Database Analysis and Design. *Journal of Information Systems Education*, 17(1), pp. 43–53.

Desai, A., Tippins, M., & Arbaugh, J.B. (2014). Learning Through Collaboration and Competition: Incorporating Problem-Based Learning and Competition-Based Learning in a Capstone Course, *Organization Management Journal*, 11(4). 258-271, doi:10.1080/15416518.2014.973793.

Dietrich, S.W. & Urban, S.D. (1995). Database Theory in Practice: Learning from Cooperative Group Projects. *ACM SIGCSE Bulletin.* August, 1996. doi: 10.1145/236462.236520.

Kolb, D.A. (1984). The Process of Experiential Learning. In *Experiential learning: experience as the source of learning and development* Chapter 2). Retrieved from http://www.learningfromexperience.com/images/uploads/process-of-experiential-learning.pdf.

Schuldt, B.A. (1991). "Real –World" Versus "Simulated" Projects In Database Instruction. *Journal Of Education For Business*, 67(1).

Society for Human Resource Management (2014). SHRM Survey Findings: 2014 Economic Conditions—Recruiting and Skills Gaps [PowerPoint Slides]. Retrieved from http://www.shrm.org/research/surveyfindings/articles/pages/shrm-economic-conditions-recruiting-skill-gaps.aspx.

Tétard, F. & Patokorpi, E. (2005). A Constructivist Approach to Information Systems Teaching: A Case study on a Design Course for Advanced-Level University Students. *Journal of Information Systems Education*, 16(2). 167-176.

Tynjälä, P., Pirhonen, M., Vartiainen, T, & Helle, L. (2009). Educating IT Project Managers through Project-Based Learning: A Working-Life Perspective. *Communications of the Association for Information Systems,* 24(16). 270-288.

Using a Multimedia Final Project in an IT Ethics Course

Elizabeth V. Howard
howardev@miamioh.edu
Computer & Information Technology Department
Miami University Regionals
Middletown, OH 45042, USA

David M. Woods
woodsdm2@miamioh.edu
Computer & Information Technology Department
Miami University Regionals
Hamilton, OH 45011, USA

Abstract

In previous semesters of our IT Ethics course, students created traditional final projects where they presented some topic in IT Ethics that we did not cover during the course. Students were free to choose how they would present their information with most groups choosing a traditional presentation where some members of the group were clearly improvising on the day of the presentation. There were a few groups, however, who would embrace the challenge for creativity and create movie trailers, mock trial scenes, or short skits. We wondered if students would feel more engaged in the course material if their final project required the creativity of a multimedia project.

Keywords: IT Ethics, Creativity, Multimedia Project, Student Engagement, Pedagogy

1. THE IT ETHICS COURSE

As previously described (Howard, 2007a, 2007b; Howard, Bulach, Carver, et al, 2009; Woods & Howard, 2013), we have used a number of activities to facilitate student engagement, preparedness, and creativity in our IT Ethics course. Our IT Ethics course is designed as a discussion and writing intensive course. The instructor does not present lectures and acts more as a moderator or facilitator during the course. Some of our course activities include guided online discussions, a hands-on activity where each student runs the Wireshark network protocol analysis software (www.wireshark.org) to capture network traffic while executing a Google search, requiring written notes that count for half of the points for quizzes to encourage students to read and be prepared for class, a variety of in-class discussions, and using contemporary films to discuss intellectual property and privacy. Students also write position papers during the semester where they must argue and support their chosen stance. In addition to citing outside scholarly and popular sources in their papers, students must also quote their classmates (quotes are typically chosen from the online discussions but students may also quote in-class discussions). We also encourage students to approach the position papers in a creative fashion and we offer extra credit for creativity. Some examples of creative student position papers include news stories, a short skit, or a letter from the future.

2. WHY CREATIVITY?

Bloom introduced his Taxonomy of Educational Objectives in 1956 and educators have used his taxonomy to move students from Lower Order

Thinking Skills to Higher Order Thinking Skills. In 2001, Anderson and Krathwol published a revised version of Bloom's Taxonomy (please see Table 1). As students move through the course, first learning the ethical theories, such as Act Utilitarianism, Rule Utilitarianism, and Kantianism, then applying the ethical theories to evaluate various scenarios, they also move through the taxonomy. By creating a multimedia project, students move to the highest level thinking skill. Creativity has been used as a motivation for engagement and learning by many of our colleagues (Burleson, 2005; Hewett, 2005; Lewandowski, Johnson, & Goldweber, 2005; Lubart, 2005; Selker, 2005; Yamamoto & Nakakoji, 2005). Multimedia projects seem to naturally provide the opportunity for creativity as Neo & Neo (2013) found when their students, in a study about creating a multimedia project, "reported finding the project inspiring and a motivating factor to complete the task and were the two highest scoring items in the survey."

The IT industry also values creativity and skills in multimedia. In a recent survey conducted by the US research company, Edelman Berland, hiring managers reported on the skills required for success in the workplace. (www.adobe.com/go/edu_creative_study.html). "Seventy-five percent of hiring managers agree the job market will change significantly in the next five years. Tech-savvy (88%), the ability to communicate through digital and visual media (82%) and creativity (76%) are cited as becoming essential skills." "Ninety-four (94) [sic] percent agree creativity is key when evaluating candidates and prefer those with creative skills over conventional skills by more than 5 to 1."

Higher Order Thinking Skills
Creating
Evaluating
Analyzing
Applying
Understanding
Remembering
Lower Order Thinking Skills

Table 1. Bloom's Revised Taxonomy

3. THE MULTIMEDIA PROJECT

For the final project, students created multimedia projects on topics about which they thought other college students would be interested. The projects had to be pre-recorded so instead of standing in front of the class and presenting their project, students played their final project for the class. Live presentation by students was only allowed if there were interactive portions, such as a discussion, quiz, or game. To help students focus on creating the project, we asked them to submit their ideas from a brainstorming session followed by a project plan explaining the milestones and deadlines for their project. The instructors reviewed the ideas and provided feedback before the due date for the project plan. During the next two (2) weeks, all groups submitted a status report detailing what they had done on the project. The status reports also included individual status updates from each group member. Finally, the groups submitted a summary, a list of references used, and the project itself. As part of the final exam, students reflected on their experience on the final project. We evaluated the projects using the following criteria:

- **Research and relevance**: Project demonstrates use of sources, accuracy, clear examples, and relevance to topic. The group demonstrated command of the topic.
- **Ethics**: Project clearly addressed ethical aspects of topic by incorporating ethical theories.
- **Clarity**: Project goal was clear. Content was clear and easy to follow.
- **Flowed Well**: Project was professional, appropriate in tone and content, of high quality, involved all members, and was cohesive in look, format, presentation, and style.
- **Attention**: Project was interesting and maintained attention of audience.
- **Creativity**: Format and/or content of the project was creative.

The instructors created a mini-version of a final project so that students could see that we, too, used creativity and could report on our own experience of being more engaged with the project. The instructors also provided a list of possible resources to edit videos, create animated videos, create automated presentations, and create audio sound effects.

4. EXAMPLES OF STUDENT MULTIMEDIA PROJECTS

One group created a movie about "Ethical Dreams and Nightmares," where the students shot several scenes, including a scene where the small daughters of one of the students presented the ethical analysis using Kantianism and Utilitarianism. One student from that group says, "To my own surprise most of the ethical issues were not faced in the scenes of our movie but more so in the editing of our movie. I had to purchase the music I wanted to use in the movie. We had to make sure that we had legal software to edit the movie. We also had to make sure we gave credit where credit was due. All of these situations were covered in IT Ethics, so encountering them in the final project was appropriate. I love the challenge of a final project but this project took the cake. I was immersed in every aspect of this project because I have a great passion for the creative work required to make a good multimedia project."

Another group created a newscast with a number of different reports on software pirating. They also created two videos. One video, in the style of the Dateline NBC's To Catch a Predator, showed a software pirate trying to buy illegal software. Their second video showed a young man downloading illegal files was reminiscent of the iconic Public Service Announcement, "I learned it from you…," from the 1980s. Both videos not only had students from the group but also had a friend and the son of one of the students acting in the video. This group also created a whiteboard video where the objects in the presentation are drawn as the dialogue plays. One of the students in this group said, "By giving us the assignment to teach a concept to others, the project forces us to understand it more fully than simply being able to copy information down into an essay response, or choosing a matching answer from a list. Because we had to translate the information into a new medium, we had to further our understanding of the material since we had to know which topics and ideas within the material were essential to inform the audience."

Another group created an animated movie for an informational program called the "Ethical Insider" focusing on the dangers of casual internet use. The students designed the story, created the animations, and all of the dialogue for the movie. The student who excitedly took on the responsibility for creating most of the animation says, "This project actually taught me a lot about ethics and the causes and effects of identity theft and online privacy. I wasn't just creating the animations; I was also learning at the same time."

One group created a video about hackers and cybercrime. The video showed two sides of hacking in a dreamlike, hypnotic style of video complete with the scary, computerized mind-controlling voice. They also integrated various news video clips showing cybercrime and how people defend against it. One student reflects, "I have learned a few things about video editing and the facts behind cybercrimes. I was unaware that so many crimes were carried out online. I think everyone in the group learned a lot about this."

One group created a Prezi (with full voiceover) on piracy, including several news stories and other pertinent information. The group also created a video showing a student trying to convince his classmate to allow him to photocopy the textbook (she declines) and then he discovers that he can illegally download a copy. One student says that the multimedia project "helps pull together skills and our group in particular was well matched, because we all had something to bring to the table and I can only speak for myself, but I really was able to take away something from this."

One group created animated movies and a Prezi about the ethics in Health Information Technology (HIT). The group reports, "Through our research, we came across different real life instances where personal health information was released to the wrong person(s) and security and privacy were violated. We learned also that there is also a big financial and legal punishment for violating HIT standards. After all of this, we can now all say that we thoroughly understand the importance of ethics in HIT."

Another group created a Prezi and animated videos about plagiarism and they found a true connection between the course and the lives of students. The group reports, "We all contributed ideas, suggestions and concerns that became the creation of a totally successful project. We believe that the ethical issue raised regarding plagiarism should be brought before the University administration and that this information should be looked at as a real solution."

One group created a quite complex set of animations covering a variety of topics, including 3d printing, regional video coding, the ethical use of video games, and how social media feeds play roles in news aggregation. Although the group encountered technical challenges (which they overcame), students still found the project worthwhile and even included their friends in the voice recording. One student says, "This format makes it so that the group has to consider—not only in the facts they present, but how they present them—all aspects of the ethics involved in their production. It made them think about what music or added/borrowed files they were using and how to avoid violating copyright protected materials. I believe everyone enjoyed their project in its final form (even if some of us had major issues in its format and design) and I really want it to continue happening in such a way that is both challenging and creative to the class."

5. STUDY AND RESULTS

Over two (2) semesters in three (3) sections of our IT Ethics course (total of 48 students), we asked students to reply to specific questions about the final project in their reflection paper for the course:

1. For your final project, did the fact that it was a multimedia project make it more or less effective than a traditional final project to increase your knowledge of an aspect of IT Ethics?
2. What did you enjoy about creating a multimedia final project?
3. What did you dislike about creating a multimedia final project?
4. Was creating a multimedia final project more engaging, less engaging, or equally engaging than a traditional final project?
5. Would you recommend that the final project continue to be a multimedia project (or simply make it a traditional final project)?

To establish reliability, two coders coded 25% of the students' reflective essays and one of the coders coded all of the essays. The coders were reliable with an agreement level of .94. One student's reflective essay was removed from the study because the student did not answer any of the questions about the final project.

Table 2 shows students' reflection on the effectiveness of the multimedia project (question #1). Eighty-two percent (82%) of the students found the multimedia project more engaging than a traditional project or made a positive comment while 4% found the project to be less effective or made a negative comment. The remaining 13% found the multimedia project equally as effective.

More	Did not explicitly say "more" but made positive comment	Neutral or Equal	Less	Did not explicitly say "less" but made negative comment
69%	13%	13%	2%	2%

Table 2. Question #1 Response (effectiveness of project)

The two most common themes that students listed about what they enjoyed about the project (Question #2) was working with their groups (44%) or a comment about creating some portion of the project or creativity (71%) with some students listing more than one theme.

Students identified the most common themes about disliking the multimedia project (Question #3) as difficulty using the application (27%), trying to schedule time with their groups (29%), and that creating a multimedia project was time-consuming (21%). Nineteen percent (19%) of students explicitly said that there was nothing that they disliked about the final project.

Table 3 summarizes the students' response to whether they found the multimedia project more, equally, or less engaging than a traditional project (question #4). Seventy-five percent (75%) of students found the multimedia project more engaging, 15% found it equally as engaging, 4% found it less engaging, and 6% did not say.

More	Equal	Less	Did not say
75%	15%	4%	6%

Table 3. Question #4 Response (engaging)

When asked if we should continue to use the multimedia project (question #5), 92% of the students said yes, 2% said no, 6% suggested that we should offer students a choice between a multimedia project and a more traditional presentation, and 2% didn't say (please see Table 4). One student said that the project was not effective and students should be given a choice.

Yes	No	Didn't say	Offer Choice
92%	2%	2%	6%

Table 4. Question #5 Response (recommend continued use of multimedia project)

6. DISCUSSION

Overall, the students report that the multimedia project helped them to better understand IT Ethics, was more engaging, and overwhelmingly recommended that we continue to use multimedia in our final project for the course. Students seemed to appreciate the opportunity for creativity rather than preparing the typical informational presentation. As with any group project, especially with students who are often working and have families, they had challenges finding time to meet. Students did note that multimedia projects are time-consuming since all of the work has to be done before the date of presentation. One student sums it up well by saying, "The use of multimedia was more engaging and more fun when we look at the final outcome. Getting there was often a detractor, but it was worth it in the end. A traditional final project, though challenging, can be stressful and not interesting. The multimedia was stressful and interesting." While we provided students with a list of possible resources to edit videos, create animated videos, create automated presentations, and create audio sound effects, students did not contact us with questions about the various applications. If a group had difficulty with an application, they would find a solution themselves, such as using a different application.

We were surprised by the enthusiasm that students demonstrated for the final project. Students made comments, such as, "it is one of the most fun and proudest moments of my college experience thus far," "joy in creating project," and "awesome to be a part of it." Quite frankly, group projects have not generally been so positively reviewed. We were also surprised by the groups who included friends and family in their projects as actors, videographers, writers of dialogues, and voiceover recorders. As educators, we hope that our courses will help students make connections in their lives and we were thrilled to explicitly see those connections in these projects.

7. CONCLUSION

As instructors, we observed that students were more excited about creating a multimedia project. They designed their own scenarios, wrote the dialogue, and created animations or recorded videos. Groups even involved their friends and families. Since the presentations were pre-recorded, groups had to communicate to create the automated presentations and students were not able to simply improvise by reading slides that their teammates had created. In their reflective paper, students report that they found the multimedia project more engaging and would definitely recommend using multimedia projects in future semesters. We will continue to use the multimedia project in the course.

One challenge is that multimedia projects can result in large files, which can be difficult for groups to share and submit. We also encourage students to explore applications that are free or offer a free trial version. These free trial versions often have a limit on the length of the video so often each student will create a portion of the video. Since this is not a course about designing multimedia projects and our main goal with creating a multimedia project is to engage students with their topic, their group, and their creative side, we allow students to submit multiple files rather than one huge file. When the groups present their project, one of the students may need to play a series of videos rather than having a fully automated presentation.

8. REFERENCES

Anderson, L.W., and D. Krathwohl (Eds.) (2001). A Taxonomy for Learning, Teaching and Assessing: a Revision of Bloom's Taxonomy of Educational Objec-tives. Longman, New York.

Bloom, B. S. (Ed.). (1956). Taxonomy of educational objectives: Handbook 1. Cognitive domain. NY, NY: McKay.

Burleson, W. (2005) "Developing creativity, motivation, and self-actualization with learning systems." International Journal of Human - Computer Studies, 63(4-5), 436-451.

Hewett, T. T. (2005) "Informing the design of computer-based environments to support creativity." International Journal of Human - Computer Studies, 63(4-5), 383-409.

Howard, E. V., T. M. Bulach, L. A. Carver, C. R. Creekbaum, R. J. Parker, and L. G. Shockley.(2009). "Perceptions of Using Creativity in an IT Ethics Course – A Case Study of Students and Instructor." The Proceedings of the Information Systems Education Conference 2009, v 26 (Washington DC): §3332. ISSN: 1542-7382.

Howard, E. V. (2007a). "Students respond to IT ethics." In Proceedings of the 8th ACM SIGITE Conference on information Technology Education (Destin, Florida, USA, October 18 - 20, 2007). SIGITE '07. ACM, New York, NY, 219-224.

Howard, E. V. (2007b). "Encouraging engagement in an IT ethics course by fostering creativity." J. Comput. Small Coll. 23 (1), 8-13.

Howard, E. V. (2006) "Facing the challenges of teaching IT ethics." In Proceedings of the 7th Conference on information Technology Education (Minneapolis, MN, USA, October 19 - 21, 2006). SIGITE '06. ACM Press, New York, NY, 95-98.

Lewandowski, G., E. Johnson, and M. Goldweber (2005) "Fostering a creative interest in computer science." In Pro-ceedings of the 36th SIGCSE Technical Symposium on Computer Science Educa-tion (St. Louis, Missouri, USA, February 23 - 27, 2005). SIGCSE '05. ACM Press, New York, NY, 535-539.

Lubart, T. (2005) "How can computers be partners in the creative process: Classi-fication and commentary on the Special Issue." International Journal of Human - Computer Studies, 63(4-5), 365-369.

Neo, M., & Neo, T. K. (2013). Exploring Students' Creativity and Design Skills through a Multimedia Project: A Constructivist approach in a Malaysian classroom. Design and Technology Education: an International Journal, 18(3).

Selker, T. (2005) "Fostering motivation and creativity for computer users." Interna-tional Journal of Human - Computer Studies, 63(4-5), 410-421.

Woods, D. and Howard, E.V. (2013). "An Active Learning Activity for an IT Ethics Course." Proceedings of the Information Systems Educators Conference 2013 (San Antonio, Texas), v30 n2551.

Yamamoto, Y. and K. Nakakoji (2005) "In-teraction design of tools for fostering creativity in the early stages of information design." International Journal of Human - Computer Studies, 63(4-5), 513-535.

A Longitudinal Analysis of the Reid List of First Programming Languages

Robert M. Siegfried
siegfrie@adelphi.edu

Jason P. Siegfried
jasonpsiegfried@yahoo.com

Gina Alexandro
ginaalexandro@gmail.com

Department of Mathematics and Computer Science
Adelphi University
Garden City, NY 11530 USA

Abstract

Throughout the 1990s, Richard Reid of Michigan State University maintained a list showing the first programming language used in introductory programming courses taken by computer science and information systems majors; it was updated for several years afterwards with the most recent update done in 2011. This is a follow-up to that last update of the Reid List. A newer list is shown and compared to the results of four years ago. The changes in popularity of different programming languages are discussed as well as some of the reasons for these changes.

Keywords: introductory programming, programming languages, objects early approach, Java, C++, Python.

1. INTRODUCTION

The choice of a programming language for an introductory programming course has been a topic of debate for over forty years, and the academic community has seen a variety of programming languages gain and then subsequently lose popularity. The difficulties that students encountered compiling Fortran programs with industry-standard compilers led Shantz et al. (1967) to develop WATFOR, a Fortran compiler for student use. Holt (1973) considered the use of PL/I a terrible way of teaching introductory programming. Kernighan (1981) described Pascal as "meant for learning" but unsuitable for serious programming, an assessment with which Haberman (1973) would have concurred. In 1996, Brilliant and Wiseman described Pascal as dated, an assessment with which many educators agreed.

The question that computer science educators have tried to answer since then is whether there exists an ideal language to use when teaching college freshmen how to program. Johnson (1995) considered C too complex a language for beginning programmers. Many college programs switched to using C++ in their introductory programming course, and the Advanced Placement exam in Computer Science switched as well. More recently, the Advanced Placement exam switched to Java, and so did many introductory programming courses. Java was widely considered an easier language to learn than C++ (Hadjerroult 1998; Madden 2002).

While the TeachRacket (originally called TeachScheme) approach has been around for a decade (Felleisen et al. 2004), it is only used in a relatively small number of colleges. More recently, Python has become somewhat popular. Mason and Cooper (2014) found that it has become widely used in programming courses in Australia and New Zealand by programs that choose not to focus on object oriented programming in the first course.

The choice of a programming language to be used when teaching introductory programming has been a "hot button" topic within the computer science and information systems communities. While the AP Computer Science curriculum still uses Java, there are many programs that are questioning whether this is the language that they ought to be using.

This study is a follow-up to a study in 2011 to determine the language of choice in computer science programs (Siegfried et al. 2012). Since most information systems majors take the same introductory programming courses as computer science majors, this is a question that should be of great interest to both communities.

Since the move away from Pascal in the 1990s, it has become more difficult to find consensus on the choice of first programming language to replace it.

2. THE REID LIST

Richard Reid taught computer science at Michigan State University and he began tracking the languages used to teach introductory programming to CS majors in the early 1990s. The List was updated when 10% or more of the included colleges changed the programming language of instruction (Reid 1992). This resulted in a new list being released approximately twice a year until Reid retired in 1999. Frances Van Scoy, a former student of Professor Reid's, updated the list until 2006.

The twenty-fourth Reid List included 410 colleges and universities, with 391 of the colleges representing the District of Columbia and 49 states (Wyoming is the only state without representation). A breakdown by region appears in Table 1. While there is reasonable geographic balance, the mid-Atlantic and southwestern states are overrepresented by the large number of schools in New York, California and Pennsylvania that are on the List. Additionally, the New England states as a whole are significantly overrepresented in comparison to its college-age population, partially due to the presence of all eight Ivy League colleges and MIT.

Table 1. Geographic Breakdown Of The US Colleges In The Reid List

Region	Colleges
New England	41
MidAtlantic (incl. DC)	87
Southeast	72
Kentucky and W. Virginia	10
MidWest	95
SouthWest	68
Northwest	16
Alaska and Hawaii	2

Table 2 shows the breakdown by the highest degree program offered in computing. There is an almost even breakdown between undergraduate, master's- and doctorate-granting departments; however, only nine of the programs were in community colleges, which are significantly underrepresented. There was one vocational/technical school on the list. This was removed from the List because it no longer offered a computing program. Six are no longer on the List for this reason. Lebanon College was removed because it closed.

Table 2. Breakdown by Highest Degree Offered in Computing

Highest Degree Awarded in Computing	Colleges
Associate's	9
Bachelor's	128
Master's	109
Doctorate	157
No longer offering a computing program	7

3. METHODOLOGY

The colleges and universities included in this survey were taken from the twenty-fourth Reid List; many of the 410 schools listed on the twenty-fourth list did not appear on the twenty-fifth list, which only listed 153 schools. The requirements for the Bachelor's program in Computer Science were examined to determine what the first required programming course was. If the school offered both Bachelor of Arts and Bachelor of Science programs, the requirements for the BS were used. In the case of the community colleges, the requirements for an Associate's degree in Computer Science were examined. Finally, if the school did not have a

Computer Science program, the requirements for the Information Systems program were used.

After finding the first programming course, the course description was examined to see if it included the programming language of instruction; however, most did not specify the language. If a current syllabus for the course was available online, then an examination of its content was used to make a determination of the language used in the course. However, if there was no syllabus online, the bookstore's web site was checked for a textbook adoption; in some cases, the bookstore was called in an attempt to get this information. Lastly, if these steps did not provide the programming language in use, then members of the department were contacted to obtain this information.

4. THE TWENTY-SEVENTH REID LIST

Table 3. The Programming Languages Used And The Frequency Of Occurrence

Language	Programs Using it
Java	180
Python	76
C++	74
C	22
Scheme or Racket	9
C/C++	4
JavaScript	2
Visual Basic	2
Ada	1
C#	1
C++ or Java	1
C++ or Scheme	1
C++ then Python	1
Haskell	1
Java and C	1
Java or C++	1
PHP and C	1
Processing or Python or C#	1
Python and C	1
Python or C0	1
Python or Matlab	1
Python or C++	1
Matlab	1
R	1
Scala	1
Visual Basic and Java	1

Of the 398 schools still offering computing programs, we were able to determine the language or languages used in 387 schools. Each language (or combination of languages) is shown in Table 3. Java is still the most common choice of language, with one hundred eighty schools using it, more than double its nearest competitor. It is followed by Python and C++, with seventy-six and seventy-four schools respectively using them. These three languages account for three hundred and thirty of the three hundred eighty-seven schools. Scheme and Racket (a Scheme-derived language) are used at 9 schools, JavaScript and Visual Basic are each used at two schools and there are one school each using Ada, C#, Matlab and Scala. In addition to these languages, there are several programs that use more than one language in a given course (in some cases, the choice of language is left to the instructor) and several that offer more than one course with which a student can begin their computing major.

These two most recent lists, the Twenty–seventh list and the twenty-sixth list (which was compiled in 2011) are compared in table 4. The changes in the popularity of the top eight languages on the list are significant: Java's popularity declined somewhat while Python's popularity grew significantly. While C++ is used in beginning programming courses in 4 fewer schools, there are 3 more schools using C than four years. Scheme and Racket's popularity faded somewhat; its significance is noteworthy because the drop represents 25% of the Reid List schools using it in 2011. Java Script appears on the current list after not appearing in 2011 and both Visual Basic and Ada have almost disappeared from the list; where Visual Basic was used in 8 schools (either exclusively or followed by Java), it is now used in only 3 computing programs. While Ada was used in 6 schools in 2001, it is now used in only one. It is also interesting to note the appearance of several languages of lesser popularity that were not on the previous list. These include PHP, Matlab, R and Scala.

Table 5 shows details that one would missed in a simple comparison. Programs that adopted C were more likely to switch from Java than from C++ or Python. And while more programs abandoned Java for Python by a large margin, other programs switched from Java to C, C#, C++ and R. There were four schools that abandoned Python for other languages which included C, C++, Java and Scala.

Table 6 shows the three most popular languages by region; the Reid Lists schools outside the United States were excluded from this listing. In seven of the eight regions, the same three languages (Java, Python and C++) appeared; in the two Reid List school in Alaska and Hawaii, only Java was used. But in the Northwest schools, C++ was the most commonly used but in every other regions, the most popular instructional language was Java. In five of these seven regions, Python was the second most popular and in the other two regions, it was C++.

5. DISCUSSION

Adelphi University switched from C++ to Java in 2002 because Nassau Community College, from which Adelphi receives a large number of transfer students, had switched to Java and in anticipation of the change in the Advanced Placement exam in Computer Science. There was also a general impression that more computer-savvy students expected to learn Java and its being an object-oriented language made it seem like the immediate future of computer science.

Mason, Cooper, and deRaadt (2012) found that most Australian computing programs based their choice of a language on its perceived pedagogic benefits and its popularity in private industry. Yet 35% of computing programs that Davies, Polack-Wahl and Anewalt (2011) surveyed taught CS1 programming courses where object-oriented programming was not taught. If one is not teaching objects early, or especially if one is not teaching objects at all in a first programming class, why use Java? This led Elliot Koffman to comment on the SIGCSE mailing list (Beaubouef and Mason 2005), "I fear that we have reinvented the 'new math' syndrome and many of us are unaware of it." Decker and Hirschfield (1994) laid out the case for teaching objects early; but there has been no empirical evidence that the objects early approach makes it easier for students to learn object oriented program than an objects later approach does. Bloch (2011) said that teaching objects early gives students an opportunity to see the difficulties in designing classes before they can possibly appreciate any of the benefits.

Prendergast (2006) wrote about the frustration in learning Java and teaching it to beginning programming students. Nor is he alone; several instructors wrote in their e-mail replies about how much easier it was to teach introductory programming in Python and a few other languages. Yadin (2011) saw fewer students fail their programming course when Java was replaced by Python as the programming language of the course.

Many instructors stated that they are still using Java or C++ in a second programming course; the implication is that they are first covering objects in their second course. This shift from one language in CS1 to an object-oriented language in CS 2 corroborates what Davies et al. found in their 2011 study.

The TeachScheme! approach has been heralded as the savior of computer science by its proponents. Bloch has written about the use of Scheme as an introduction to programming before transitioning to Java, crediting it with curtailing attrition in the CS2 course. Yet only one of the schools using Scheme on the sixth Reid List in 1992 was still listed as using it in the twenty-sixth list in 2011. And Scheme and its derivative language Racket are currently only used in 9 schools on the twenty-seventh Reid List. Bloch's former college stopped using Scheme in 2006 in the CS1 course and is currently phasing it out from the programming course for non-majors. A faculty member (Anonymous 2011) at a Reid List school that switched away from Racket explained that the decision was made to reverse the heavy attrition rate in their major after the first programming course. A faculty member (Anonymous 2015) at another Reid List school said that they dropped it because "the Scheme enthusiast finally retired."

The shift toward Python should not be surprising given McIver's (2002) observation about how large an elementary Java program is compared to a comparable program in Python or in C. Mannila and de Raadt examined the suitability of several programming languages for use in an introductory course and favored Python and Eiffel although they did find some merit in Java.

It is difficult to believe that this debate will be resolved any time soon. There was a time when it seemed like PL/I or Pascal would be the programming language of the future of computer science education. And Python is not without its critics. Michael Main (private communication, 2009) indicated that he considers it important that students learn how and why to declare the data types of variables in a program. Similarly, a programmer friend of a colleague said that he did not prefer Python because it is harder to locate certain types of bugs due to its lack type checking (Chays, private communication, 2015).

While there is some fluctuation from one region to another, it is not that significant. All Java remains very popular with Python and C++ as the most common alternative. Given that the choice programming language is the subject of an international discussion, this is not too surprising.

There will most likely be another language that will usurp the place that Python currently hold in the hearts of computer science faculty. And it will most likely be the cause of continued debate within the computer science and information systems communities.

6. ACKNOWLEDGEMENTS

The authors gratefully acknowledge the computer science and information systems faculty at the colleges and universities on the Reid List for your gracious assistance in collecting this data.

7. REFERENCES

Anonymous (2011). Private communication.

Anonymous (2015) Private e-mail.

Beaubouef, T., & Mason, J. (2005). Why the High Attrition Rate for Computer Science Students: Some Thoughts and Observations. ACM Inroads 37(2), 103-106.

Bloch, S. (2000). Scheme and Java in the First Year. Journal of Computing in Small Colleges 15(5), 157-165.

Bloch, S. (2011). Private communication.

Brilliant, S. S. & Wiseman, T. (1996). The First Programming Paradigm and Language Dilemma. ACM SIGCSE Bulletin 28(1), 338-342.

Chays, D. (2015) Private communication.

Davies, S., Polack-Wahl, J. A., & Anewalt, K. (2011). A Snapshot of Current Practices In Teaching the Introductory Programming Sequence. ACM SIGCSE Bulletin 43(1), 625-630.

Decker, R. & Hirschfield, S. (1994). The Top Ten Reasons Why Object Oriented Programming Can't be Taught in CS 1, ACM SIGCSE Bulletin 26(1), 51-55.

Felleisen , M., Findler, R. B., Flatt M., & Krishnamurthi, S. (2004). The TeachScheme! Project: Computing and Programming for Every Student. Computer Science Education 14(1), 55-57.

Haberman, A. N. (1973). Critical Comments on the Programming Language Pascal.", Acta Informatica 3 (1973), p. 47-57.

Hadjerroult, S. (1998). Java As First Programming Language: A Critical Evaluation. ACM SIGCSE Bulletin 30(2), 43-47.

Holt, R. C. (1973). Teaching the Fatal Disease or Introductory Computer Programming Using PL/I. ACM SIGPLAN Notices 8(5), 8-23.

Johnson, L. F. (1995). C In The First Course Considered Harmful. Communications of the ACM 38(5), 99-101.

Kernighan, B. W. (1981). Why Pascal Is Not My Favorite Programming Language. Computing Science Technical Report No. 100, AT&T Bell Laboratories.

Madden, M. & and Chambers, D. (2002). Evaluation of Student Attitudes to Learning the Java Language. Proceeding of Conference on the Principles and Practice of Programming in Java, (Trinity College Dublin), 125-130.

Main, M. (2009). Private communication.

Mason, R., Cooper G., & De Raadt, M. (2012). Trends In Introductory Programming Courses in Australian Universities – Languages, Environments and Pedagogy. Proceeding of the Fourteenth Australasian Computing Education Conference (ACE 2012), Melbourne, Australia. Conferences in Research and Practice in Information Technology 123.

Mason, R., & Cooper, G. (2014). Introductory Programming Courses in Australia and New Zealand in 2013 – Trends and Reasons. ACE '14 Proceedings of the Sixteenth Australasian Computing Education Conference 148, 139-147.

McIver, L. (2002). Syntactic and Semantic Issues in Introductory Programming Education. Ph. D. Thesis. Monash University, Melbourne Australia. Received from the author, June 30, 2007.

Prendergast, M. O. (2006). Teaching Introductory Programming to IS Students: Java Problems and Pitfalls. Journal of Information Technology Education, 5(1), 491-515. Retrieved from http://www.editlib.org/p/111559/, July 15, 2015.

Reid, R. J. (1992). First Course Language for Computer Science Majors. Retrieved from http://www.csee.wvu.edu/~vanscoy/REID06.html on July 12, 2011

Shantz, P. W., German, R. A., Mitchell, J. G., Shirley, R. S. K, & Zernike, C. R.(1967). WATFOR – The University of Waterloo FORTRAN IV Compiler. Communications of the ACM, 10(1), 41.44.

Siegfried, R. M., Greco, D. M., Miceli, N. G., & P. Siegfried, J. P (2012). Whatever Happened to Richard Reid's List of First Programming Languages? Information Systems Education Journal, 10(4), 24-30. Retrieved from http://isedj.org/2012-0/N4/ISEDJv10n4p24.pdf on July 5, 2015.

Van Scoy, F. (2006). Reid List 25. Retrieved from htpp://groups.google.edu/group/comp.edu/browse_thread/thread/4f00b5f437ce261a/3267514419052033?q=Reid+List#3267514419052033 on July 15, 2011.

Yadin, A. (2011). Reducing the Dropout Rate in an Introductory Programming Course. ACM Inroads, 2(4), 71-76.

Appendices and Annexures

Table 4. A Comparison of the Twenty-Seventh and Twenty-Sixth Reid Lists

	2015	2011
Java	180	197
Python	76	41
C++	74	80
C	22	19
Scheme or Racket	9	12
C/C++	4	4
JavaScript	2	0
Visual Basic	2	7
Ada	1	5
C#	1	0
C++ or Java	1	2
C++ or Scheme	1	0
C++ then Python	1	0
Haskell	1	1
Java and C	1	0
Java or C++	1	0
PHP and C	1	0
Processing or Python or C#	1	0
Python and C	1	0
Python or C0	1	0
Python or Matlab	1	0
Python or C++	1	0
Matlab	1	0
R	1	0
Scala	1	0
Visual Basic and Java	1	0
Ada or Python	0	1
Alice	0	1
Alice and Java	0	2
Java or Matlab	0	2
Java or Python	0	1
Java or Scheme	0	1
Processing	0	1
Processing and Java	0	1
Python and Java	0	1
Python or Java	0	1
Python Or C# or Matlab	0	1
Various Languages	0	1
Visual C# or Visual Basic	0	1

Table 5. The Languages That Computing Programs Adopted And The Language From Which They Switched:

Schools adopting:	Changed from:	
C	C++	2
C	Java	4
C	Python	1
C#	Java	1
C++	C	1
C++	Java	9
C++	Processing/Java	1
C++	Python	1
Java	Ada	3
Java	C	1
Java	C#	1
Java	C++	11
Java	Processing	1
Java	Python	2
JavaScript	Visual Basic	1
PHP and C	C++	1
Python	Ada	2
Python	Alice/Java	1
Python	C	1
Python	C++	6
Python	Java	28
Python	Scheme	2
R	Java	1
Scala	Python	1

Table 6. The Three Most Popular Languages By U. S. Region:

New England	Mid-Atlantic (including D. C.)	Southeast	Kentucky & West Virginia	Midwest	Southwest	Northwest	Alaska & Hawaii
Java	Java	Java	Java	Java	Java	C++	Java
Python	Python	C++	Python	Python	C++	Python	
C++	C++	Python	C++	C++	Python	Java	

Edugamifying Media Studies: Student Engagement, Enjoyment, and Interest in Two Multimedia and Social Media Undergraduate Classrooms

Robert Bajko
rbajko@ryerson.ca
School of Professional Communication
Ryerson University, Toronto, Ontario

Jaigris Hodson
jaigris.hodson@royalroads.ca
Office of Interdisciplinary Studies
Royal Roads University, Victoria, British Colombia

Katie Seaborn
kseaborn@mie.utoronto.ca
Mechanical & Industrial Engineering
University of Toronto, Toronto, Ontario

Pamela Livingstone
pamela.livingstone@ryerson.ca
Yeates School of Graduate Studies
Ryerson University, Toronto, Ontario

Deborah Fels
dfels@ryerson.ca
Ted Rogers School of Information Technology Management
Ryerson University, Toronto, Ontario

Abstract

Gamification is an increasingly acceptable alternative to traditional classroom structures and practices that is based on the notion that games can be engaging to students. Gamification consists of applying game concepts such as challenges, rewards, and leaderboards to educational materials and courses. While gamification in the classroom is not new, there has been little research on comparing the same or similar gamification approach in different types of courses. To understand the impact of gamification on student engagement, enjoyment, and interest, two university-level undergraduate courses—one on multimedia and one on social media—from different teaching departments were similarly gamified and evaluated. Students found gamification to be a positive and engaging aspect of course. Competition, being able to gain experience points, challenges, and quests inspired students to take greater interest in the course, including seeking out additional materials. However, there was a difference in attitudes and expectations among gamers and non-gamers. Departmental rules, conventional thinking by others, and restrictions on content delivery methods acted as deterrents to gamified course development.

Keywords: Gamification in education, gamifying education, gameful design, game-based learning, engagement, social media, multimedia.

1. INTRODUCTION

Educational instructors have begun to explore the idea of gamification as an engagement strategy within their course syllabus (Hanhus & Fox, 2015; Cheong, Filippou, & Cheong, 2014; Iosup, & Epema, 2014; Barata, Gama, Jorge, & Gonçalves, 2013; Berkling & Thomas, 2013; Cheong, Filippou, & Cheong, 2013; Giannetto, Chao, & Fontana, 2013; Sheldon, 2011). Gamification is about taking typical game elements such as leaderboards and applying them to course content (Deterding, Dixon, Khaled & Nacke, 2011; Deterding, Sicart, Nacke & O'Hara, 2011). But designing gamified courses requires more than just taking gamified elements and applying to them course content: it requires strategic understanding of how certain elements can affect students' learning (Kalinauskas, 2014).

This research focuses on the gamification of two fourth-year, elective undergraduate courses within media studies: social media and multimedia. This paper is an expanded version of the paper presented at the Information Systems and Computing Education (EDSIG) conference (Bajko, Hodson, Seaborn, Livingstone & Fels, 2015). In this paper, we focus on initial findings for student engagement in the course material, interest in the course material, the learning benefits that came from student and professor's interests, the overall enjoyment of the course and the gamified elements, and some challenges that the instructors encountered in carrying out a gamified curriculum in different departments and with different kinds of students, particularly based on gamer status.

Engagement, Enjoyment, and Comprehension

Gamification was first used in marketing to drive engagement among customers (Ewing, 2012). Since that time, it has been used in many different areas, including, if not especially, education (Kalinauskas, 2014). By applying gamified elements to course work, there can be opportunities to encourage greater creativity and engagement in the classroom because students/players believe that they are a part of something greater than the course (Kalinauskas, 2014). Gamification has also been shown in healthcare education to increase students' comprehension of and confidence in course material (Shawaqfeh, 2015). This can translate into an increased willingness to actively engage with course concepts and activities, rather than feeling as though they are forced to complete course activities within given parameters (Cheong et al., 2014; Kalinauskas, 2014; Bruder, 2014). In particular, Bruder (2014) suggests that students like to be rewarded for their accomplishments in tangible, creative and challenging ways, similar to the way in which games operate. Another element of gaming that is commonly used in gamification is the social aspect, where players build teams, complete quests, and learn together (Giannetto et al, 2013). Through gamification, it is possible for students to find fun and challenging ways to engage with course content that allow them to enjoy themselves as part of a "game" while learning course material (Cheong et al, 2014; Kalinauskas, 2014). For detailed surveys of different examples of gamification that go into descriptions of specific gamification elements in greater depth, refer to Sheldon (2011) and Seaborn & Fels (2015).

Structure and Development

A major challenge when designing gamification for education is the limits imposed by the structure and rules implemented by the program department (Berkling & Thomas, 2013). Sometimes what professors want to do and what they are allowed to do are mismatched, which can result in a restriction on innovation and academic freedom and/or a disregard for departmental/institutional norms, depending on the point of view. Departmental norms may dictate grades being allocated in a specific way, for example with letter grades based on percentages, while gamification often means using alternative reward systems, such as experience points (XP) and badges.

Another major challenge is that people have different ideas of what gamification is and how it should be applied in the educational system (Berkling, & Thomas, 2013). Students with different backgrounds and/or expectations in gaming may have different understandings or about the course management or how games should be used. For example, if students believe that gamification means a free or open learning structure and high-quality visuals (similar to console games) when that is not the case, there can be a negative reaction towards gamification and the course (Berkling & Thomas, 2013).

Student expectations must be anticipated and recognized within the course structure for two reasons. First, so that there is flexibility in managing those expectations. Second, so that there can be opportunities for negotiation and experimentation within departmental curriculum management structures with the goal of maximizing student engagement and learning. During course development and planning, questions such as "how will gamification applied in a specific course affect student engagement and learning, as well as the course learning objectives?" should be asked rather than simply applying arbitrary standards of course development.

Gamer vs Non-Gamer Students

When designing a gamification layer, understanding the needs and expectations of the students is key (Kim, 2015). Like gamers, many students have different motivations to be in class and may have different expectations for gaming or game elements based on their own experiences with games. Richard Bartle (1996) suggests that there are four main types of game player: competitors, explorers, achievers and socializers. To engage a wide variety of students, gamification elements, such as leaderboards and badges, need to appeal to different types of players, which can make the design process challenging (Bruder, 2014). Here are some examples: Leaderboards may be of interest to competitors and achievers but not to explorers or socializers. Having the opportunity to participate in a group or guild may appeal to socializers but not competitors. Asking students to find and use external resources to solve problems may appeal to explorers and competitors but not achievers or socializers.

Ideally, gamification elements applied to a course should appeal to all the different types of game player in order to be useful for a wide variety of learners. However, this makes gamification elements difficult to apply to education, and indeed it is not as simple as making students compete against each other and using a leaderboard (Bruder, 2014). Appealing to a wide variety of students with varied understandings of gaming and designing content that reflects that variety makes for a difficult design process that takes time and innovative thinking.

Content and Delivery

Content and delivery refers to what specific elements are created for students and what media are used to convey this content (Kim, 2015). As stated previously, a lack of console-gaming style visuals can be an issue for some students, but content style, gamification elements, and general motivation within the course can also be of concern (Berkling & Thomas, 2013). In addition to the different player types, there are also different learning styles. A typical classification of learning is: visual (learners like to have information presented visually/graphically), auditory (learners prefer to learn through listening to data), reading-writing (to read or take text notes to aid in learning), and kinesthetic (to learn through doing) (Prithishkumar & Michael, 2014). These are mutually exclusive categories and many learners embody more than one learning style in their learning patterns. As a result, how learning and gamification materials are presented must take into account these different preferences and not rely on a visual only medium for presenting or applying gamification elements.

In summary, designing gamification elements for the classroom is not as simple as presenting a leaderboard and encouraging students to achieve the highest score (Bruder, 2014). In order for a gamification approach to be successful, there needs to be many different elements taken into consideration, including engagement, enjoyment, comprehension, structure, audience, and the medium of delivery.

2. METHODS

The gamification and data collection of two undergraduate courses was conducted in the winter term of 2015 (January 12 - April 10); see appendix A for questions used. For the purposes of this preliminary paper, only descriptive quantitative data supported by select student and instructor commentary is presented.

Research Questions

We focused on the following research questions:

1) What were students' perceptions of and attitudes towards the gamification elements in terms of engagement, enjoyment, and course interest?
2) Was there a difference between gamers and non-gamers?
3) What challenges emerged for instructors implementing the gamified aspects of the course?

Survey Instrument

An online survey was developed and distributed to the three CMN 450 classes and the one ITM 445 class during the seventh week of class (week of March 2nd, 2015) and the twelfth week of class (week of April 9th, 2015). The survey was made available during class for a period of 45 minutes. Students' responses were coded by allocating a unique number to each person.

The survey was composed of 37 questions organized into five sections. The first section contained eight questions to collect demographic information such as the course they were enrolled in, which year in their program they were in, gender, age, the program of study, how often they play video games, and what genre of video game they play. The demographic question did not appear on the questionnaire administered at the end of the course. The second section contained eight 5-point Likert scale questions and asked participants about their enjoyment of class (e.g., "Rate your level of enjoyment with this course so far") using the Class Satisfaction and Class Effort questions (Cronbach alpha = 0.70) from Hanus & Fox (2015). The third section contained eight questions related to students' enjoyment of specific gamification elements. (e.g., "I don't enjoy working on guild/team tasks," "Levelling up in this course makes sense to me"). These were developed by the research team for this specific survey instrument. The fourth section contained 13 5-point Likert-scale questions that collected data about grades and perceived performance using the student engagement questionnaire developed by de Byl (2012) (Cronbach alpha = 0.74). This section contained three common questions related to CMN 450 and ITM 445, and five questions that were course specific to each course. The fifth section asked five questions about the overall impression of the course style that was developed for this particular survey instrument.

Participants

Seventy-six students completed the mid-course survey (seventh week of class), and seventy students completed the end of the term survey (twelfth week of class). Not all questions were completed by all participants. Forty-nine of the participants were females, twenty-three were males, and four chose "another or N/A." Sixty-seven were between 18-24 with seven being between 25-29 and two between 30-40. Eight participants were in their first year of university, twenty-two were in their second year, thirteen were in their third year, and thirty-one were in their fourth year. Since both courses were offered from the business and communication departments, almost all the participants reported their program of study to be either communication (37) or business (36). One student was in engineering, another was in the arts, and one did not respond to this question. Thirty-seven students reported they play games daily or weekly, sixteen sometimes, and sixteen infrequently. Six never play games. The top three games played were puzzle, platformers, and sandbox.

Gamification Description

Two media studies courses in different departments at the same university—CMN 450 Participatory Media and Communication and ITM 445 Multimedia in Business—were gamified following the works of Kaufman, Chandross & Gurr (2005) and Sheldon (2011).

The gamification layer in CMN 450, the social media course, was entitled *Social Media Celebrity*. The object of the game was for students in teams of five to earn experience points (XP) by completing quizzes and in class activities, and also earn popularity points through a series of dice rolling challenges. The choice of dice rolling or chance-based activities along with skill-building or experience-based activities was quite deliberate, and designed to reflect the art of creating participatory media, in which experience plays a role in the popularity of a web series or social media post, but luck also plays a large roll. Each week, CMN 450 was structured beginning with a forty-five minute lecture and application activity led by the instructor, followed by a thirty-to-forty-five minute student presentation or activity, and then followed by a break. The students would play through the in class game, which began with a quiz, then included team-based quests (for participation marks and experience points) and ended with a dice rolling activity in which students could earn game related popularity points.

Weekly quizzes were designed to test students' knowledge of assigned readings, and completing these quizzes helped students earn marks toward their final grade for the course, and also earn experience points for their team. Quests were completed in teams and the nature of the activity represented an application of the course material. For example, in the week related to visual participatory communication, students created an infographic related to a concept from the readings (as in Matrix & Hodson, 2014; see Appendix B for examples of the weekly quests). Students could and often did complete more than one weekly quest, depending on how quickly they could work as a team. Following the quests, each group was given the option to complete a dice rolling challenge. The dice rolls could result in a gain in popularity points, a loss in popularity points, or a group challenge, in which students played a fast paced question and answer game against another team of their choosing. Student teams could only win the game if they completed at least one dice rolling challenge, as a win required both popularity points (available only through dice rolling) and experience points (gained through quizzes and quests). The game ran every week except for the first, last and the midterm week, for a total of nine rounds of the game, one round per week. Quests became progressively more challenging and drew on more skills from the course as the game progressed. The most prolific team in CNM 450 completed up to three or four quests in a forty-five minute period, while the average number of quests completed was two. By the last week of the class, one team was declared the winner, and received a minimum value prize (chocolate bars or dollar store party favours).

The entire multimedia-based ITM 445 course was gamified. This included XP as grades, teams conceptualized as guilds, solo and group (guild) activities/assignments, pop challenges, duels (guild against guild), and a leaderboard. The backstory was that an evil director had stolen all of the files and staff from a multimedia production house. New people (students) were being brought into the company to start afresh. Students divided themselves into groups/guild of four and then chose a responsibility within their guild. There were four possible responsibilities that reflected different types of management activities: 1) Architect who was responsible for the overall planning and timeline management; 2) Explorer who was responsible for finding resources; 3) Scribe who was responsible for managing the reporting and writing tasks; and 4) Orator who was responsible for managing presentations or oral responses to guild challenges. Detailed tasks on assignments and challenges required participation by all guild members but each person also was required to take on their selected management role throughout the course. Examples of different activities included: the solo maker activities which were hands on laboratory tutorials to learn software applications and HTML, a project proposal, and the final exam. These were designed to appeal to the achiever, explorer and competitor type gamer. Guild activities included the production of a multimedia project and a guild presentation of one week's reading materials and weekly guild challenges. Guilds were required to have a gamified element in presentations (to which they could assign XP to classmates for correct responses). These activities were designed to appeal to all of the different gamer types. Weekly guild challenges were selected by rolling dice: one to choose the guild and one to choose the challenge. There were four possible challenges: 1) history challenges covering the previous week's materials; 2) current week's materials; 3) maker challenges covering the hands on portion of the course; and 4) duels where two guilds would compete for XPs in one of the other challenges (designed for the competitors in the class). Members of other guilds could act as helpers during the challenges (e.g., by providing answers to questions) and if the assistance was accepted, points to the assistant were awarded (designed to appeal to the socializers and explorers of the class). Challenges used a variety of techniques, such as multiple choice quizzes, tic-tac-toe, crossword puzzles, word scramble, and a Jeopardy-like game (see Appendix B for an example). Experience points were awarded for all activities and challenges; a maximum of 2000 XP (a grade of A+) could be achieved.

3. RESULTS & DISCUSSION

Student Engagement

At the mid- and endpoints of the course, students reported that they felt more engaged with the course material as a result of the gamification element, stating that it, "keeps students engaged" or it is "engaging and interesting" and "encourages team work and it pushed me to learn in a more fun and interactive way." At the midpoint, 91% reported that they found the course enjoyable or very enjoyable while 88% reported the same findings at the end of the term. They reported that they felt the gamification aspects were a good use of time, rather than a waste of time, and that it encouraged them to participate when they otherwise may not have been inclined to do so. At the midpoint and at the end of the term, 88% and 85% respectively disagreed that the course did not hold their attention at all. They stated that the points system encouraged them to learn, and the competitive part of the gamification layer encouraged them to push themselves harder, such as in the comment "I … like the competitive nature of gamification I think that in a competitive person like myself, it drives me to want to 'win'." These positive outcomes are also reflected in the standard end of term course surveys issued to students. Further, we noticed an apparent difference in student participation in class compared to similar non-gamified courses taught previously or concurrently. As also found in Barata, Gama, Jorge & Gonçalves (2013), students appeared to be spending a greater amount of time on task with activities and were more productive during teamwork time when they were completing quests. For example, we noticed that as students would complete a quest or a quiz, they would ask for more work so as to get ahead in the game. In contrast, when students would complete a similar activity in a non-gamified course, they would often leave the classroom or go off task, rather than actively seek out additional work.

Interest in the Course Material and Learning Benefits

The increased level of student engagement offers a host of benefits to student learning stemming out of an elevated interest in the material being taught. Students reported that the gamified elements "make the course content easier to understand through practical application of our learned skills" and "it allowed us to apply what we learned during the lecture to these tasks so that it was a firsthand experience." Like Cheong, Filippou & Cheong (2013), our students stated that the gamification elements allowed them to apply or experience concepts in a practical way, rather than just reading about theory. For example, "I found that I could relate to the concepts better as we did our games because we are applying them to it. It has been helpful, and I learned more than just the concepts, but also how to use the platform" and "I liked how it encouraged me to learn in a different way as opposed to the traditional method of coming to lectures and listening to the prof, and studying on my own. It also encouraged me to talk to other people and collaborate with them." 93% reported at the end of the term they agreed or strongly agreed that the weekly challenges and/or presentations encouraged them to participate with other students. This, the students thought, contributed to their course outcomes, as they were able to retain course concepts more solidly, particularly beyond the 12-week period of the course; as one student stated: "Concepts learned became more permanent as opposed to memorizing the course content and forgetting them at the end of the semester."

The gamification elements also encouraged students to learn in different ways. For example, teamwork, which is usually a much maligned "necessary evil" of teaching, became an asset when students were encouraged to cooperate with their team in order to progress in the game. Students stated "I like that it encouraged more participation and created a sense of drive to do well in class. I liked that I could be somewhat competitive as I pushed myself to work harder" and "I enjoyed working together with my group and using the gamification element as a study tool to review weekly content." 88% reported at the end of the term that they disagreed or strongly disagreed that they did not enjoy working in groups. Notably, this blend of cooperative team-based competition, rather than strict competition alone, may be one reason our students enjoyed game-based learning. This is in contrast to studies such as the one by Hanus & Fox (2015) which showed negative outcomes from applying solely competitive gaming elements to the classroom.

Overall Enjoyment

Many students reported an increased overall enjoyment with ITM 445 and CMN 450, particularly when compared to other, non-gamified classes (72.5% rated their enjoyment of the class as either enjoyable or very enjoyable). Some students commented that it made the general structure of the course feel "fresher" or revitalized, as in the comment: "It brings an element of freshness and excitement to the already stale grading system" and "I liked the class interaction and more hands on structure that was imparted through the weekly challenges and labs. It was a nice change from my other classes with 3 hour long PowerPoint lectures." Students also commented on the fact that, unlike a traditional educational environment, they found that the gaming elements helped to relieve school related stress, rather than contributing to it, as in the comment: "Some things that I liked from this gamified course was the fact that it had some resemblance to the games I play daily, in which I use to de-stress and relax. Thus, when I come to this course, I tend to have more fun and not feel more pressure from school." In ITM 445 and CMN 450, a majority of students rated the course as "enjoyable" or "very enjoyable" (73% and 91% respectively). Finally, for some students, the course set a positive tone that influenced the rest of their day outside of class. As one student noted, "I enjoy getting to work with a good team and do something that is both interactive and enjoyable. Especially since the class is at 8am, I enjoy being able to interact and get moving so early so that I am more awake for the rest of the day."

Challenges

In developing and running the course, we encountered challenges related to: 1) department structure and rules, 2) gamers vs. non-gamers, and 3) content and delivery. This next section details the various challenges we experienced and how they affected each course.

Challenges of Structure and Department Rules

While we were able to secure special permission from the department to run ITM 445 as a fully gamified course, CMN 450, hosted in a different department at the school, was treated differently. There were concerns at the department level that if grades in CMN 450 were translated into XP instead of the usual percent per assignment measures employed in the course, the department would be open to an influx of student final grade challenges from those taking the course. As a result, we had to develop two concurrent measures for student success in CMN 450. The first was the regular system of grading, tied to assignments and participation. The second was the in-class game in which the students could earn their experience and popularity points. Thus, even though students earned participation marks by participating in the game, these participation marks had no correlation to the experience points in the game. Although we were initially concerned that not tying marks directly to points in the game would make students less likely to participate, student feedback did not support this. In fact, the act of gamifying the course alone seemed to impact student engagement positively. In the open-ended survey questions, students in both courses reported only some minor dissatisfaction with each course's structure.

Challenges of Gamers vs. Non-Gamers

When designing the gamification layer, we assumed that many students would be casual gamers who were familiar with casual app-based mobile games and perhaps casual analog games, such as Monopoly or Scrabble. Likewise, we assumed that most would have limited experience with other forms of gaming, particularly complex analog or console/PC gaming. We attempted to design a gamification layer for each course that was accessible to a casual gamer or even non-gamer audience, and would allow these students to adopt it without undue frustration while still keeping experienced gamers engaged. To this end, our approach to gamification was relatively successful. However, we received some critical comments, such as the following from a student who identified as an "avid" gamer:

> I'm a very avid gamer, as soon as I heard the course was gamified I was so excited. But I think the main thing … the main sort of game, is there's a goal at the end. And there really wasn't any sort of clearly defined goal, and there wasn't any reward. When people ask if we get something at the end, and we're told no, then what's the point? …[]...I just found a lot of the elements seemed very forced together, there was no point to them, we were doing a bunch of side quests and no main quests.

In contrast, the opposite seemed to be true for some students who identified as non-gamers, such as in the case of one student who commented, "I find it sometimes difficult to understand. Great for people who love gaming, not as great for those who don't." However, for the most part, we strove for a balanced approach, and this was reflected in a consistent level of engagement throughout the course: 77% reported that they disagreed or strongly disagreed with the question "this course didn't hold my attention at all."

Worth noting here is that although students in general are becoming more familiar with the act of gaming, there is still a skill and engagement difference between those who regularly engage with complex gaming environments and those who are casual gamers or non-gamers. Those who regularly game in complex massively multiplayer online role-playing games or console based games may find it easier to pick up course game mechanics, but may also find themselves more quickly dissatisfied because the classroom gaming experience cannot easily or quickly adapt to higher-performing players.

Challenges of Content and Delivery

While we initially envisioned a digital gamification layer for the course, time, and infrastructure constraints resulted in both courses being gamified in a primarily analog format, with a text-based rule book and blended (online and offline) activities. In addition, we used a Learning Management System (LMS) to deliver the quests and accept the submissions of completed quests. This blended format resulted in some challenges to delivery, mostly because the LMS was not optimized for any type of gamification at the time. While other LMS's may offer some gamification features, these LMS's were not viable for us because we were bound to the LMS offered by our university. As seen in Berkling and Thomas (2013), some students in our courses reported that the blending of the analog game elements with minimal LMS tracking was not optimal for their playing experience, such as the student who, when asked about what they disliked about the gamification approach, reported, "It would be better if the stats were electronic and updated in real-time." Despite a few comments on the nature of the delivery, our experience shows that even an LMS that was not immediately conducive to creating course games could be used in a blended context, with some creativity on the part of the instructional team.

In order for gamification to work seamlessly for the students, additional content must be continually created beyond that which would be created in a traditional course. In our case, we often had to create two or three additional quizzes for each week of material and three or four additional quests of activities. Different teams

tended to complete quests at different speeds, and so a continuous stream of new quests needed to be provided to keep students engaged.
It is also difficult to recycle content year after year if, as in the case of ITM 445, the instructor intends to count quests toward course grades, rather than just using the gamification layer as an opportunity to encourage participation in activities. Furthermore, when the entire course is gamified and applied to the student's final grade, each activity must maintain a certain standard of rigor and be related to general course and program outcomes. Thus, the gamification of even part of an undergraduate course is an intense human resource endeavor, but can be made more manageable if course game content is used in multiple years or sections, and is tied to the general participation mark, rather than the full course grade.

4. CONCLUSION

This paper reported on preliminary quantitative data that was gathered from students attending two gamified undergraduate courses where game elements were used as part of the curriculum. Students in both courses were not only engaged but also willing to do extra preparation for the course. An important contribution to the educational process is that gamification can increase student engagement, although the impact on objective performance measures, such as grades, remains uncertain. Furthermore, introducing gamification to any course requires new ways of thinking and tools that simplify the process and work within existing structures.

5. ACKNOWLEDGMENTS

We thank all the participants who completed the survey and the Learning and Teaching Office at Ryerson University for funding this project.

6. REFERENCES

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013). So Fun It Hurts–Gamifying an Engineering Course. In *Foundations of augmented cognition* (pp. 639-648). Springer Berlin Heidelberg.

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research, 1*(1), 19.

Bajko, R., Hodson, J., Seaborn, K., Livingstone, P. & Fels, D.I. (2015). Guilds, die rolls, and leaderboards: Gamification of two undergraduate multimedia and social media courses. In *Information Systems and Computing Education (EDSIG), 2015 Conference on* (paper n3460). ISCAP.

Berkling, K., & Thomas, C. (2013, September). Gamification of a Software Engineering course and a detailed analysis of the factors that lead to its failure. In *Interactive Collaborative Learning (ICL), 2013 International Conference on* (pp. 525-530). IEEE.

Bruder, P. (2014). GAME ON: Gamification in the classroom. *The Education Digest, 80(7)*, 56-60.

Cheong, C., Filippou, J., & Cheong, F. (2014). Towards the gamification of learning: investigating student perceptions of game elements. In Journal of Information Systems Education (Vol. 25(3)). Melbourne, Victoria, Australia.

Cheong, C., Filippou, J., & Cheong, F. (2013). Understanding Student Perceptions of Game Elements to Develop Gamified Systems for Learning. In *PACIS* (p. 202).

de Byl, P. (2012). Can digital natives level-up in a gamified curriculum. *Future challenges, sustainable futures. Ascilite, Wellington*, 256-266.

Ewing, T. (2012). Where gamification came from and why it could be here to stay. *Quirk's Marketing Research Media*, 30.

Giannetto, D., Chao, J., & Fontana, A. (2013, July). Gamification in a social learning environment. In *Proceedings of the Informing Science and Information Technology Education Conference* (Vol. 2013, No. 1, pp. 195-207).

Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education, 80*, 152-161.

Iosup, A., & Epema, D. (2014, March). An experience report on using gamification in technical higher education. In *Proceedings of the 45th ACM technical symposium on Computer science education* (pp. 27-32). ACM.

Kalinauskas, M. (2014). Gamification in fostering creativity. *Social Technologies*, (01), 62-75.

Kaufman, D., Chandross, D., & Gurr, A. (2005). Key Factors in the Design of Effective Games: Results of a Survey of Industry Experts and Advanced Gamers. In *DIGRA Conf.*

Kim, B. (2015). Designing Gamification in the Right Way. *Library Technology Reports, 51*(2), 29-35.

Matrix, S., & Hodson, J. (2014) Teaching with infographics: Practicing new digital competencies and visual literacies. *Journal of Pedagogical Development 4*(2) Available from http://www.beds.ac.uk/jpd/volume-4-issue-2/teaching-with-infographics.

Prithishkumar, I. J., & Michael, S. A. (2014). Understanding your student: Using the VARK model. *Journal of postgraduate medicine, 60*(2), 183.

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies, 74*, 14-31.

Shawaqfeh, M. S. (2015). Gamification as a Learning Method in Pharmacy Education. *J Pharma Care Health Sys S2-004. doi, 10*, 2.

Sheldon, L. (2011). *The multiplayer classroom: Designing coursework as a game*. Cengage Learning.

Appendix A

Questionnaire

Purpose: To collect information on your experience with and opinions about the gamification elements used in this course. The questionnaire should take about 20 minutes to complete. Your response will be recorded anonymously.

1. **Please type in your participant code: __________________**

2. **What course are you taking?**
   - ☐ ITM445
   - ☐ CMN450

3. **What year are you in?**
   - ☐ 1st year
   - ☐ 2nd year
   - ☐ 3rd year
   - ☐ 4th year

4. **What is your gender?**
   - ☐ Male
   - ☐ Female
   - ☐ Another gender

5. **What is your age? Select a range:**
   - ☐ 18-25
   - ☐ 25-29
   - ☐ 30-35
   - ☐ 36-40
   - ☐ 40+

6. **What is your program of study?**
   - ☐ Business
   - ☐ Engineering, Math, or Computer Science
   - ☐ Life Sciences, e.g. Biology, Chemistry, Physics, Psychology
   - ☐ Community Services, e.g. Nursing, Midwifery, Public Health
   - ☐ Communication and Design/Applied Arts, e.g. Image Arts, RTA, Fashion
   - ☐ Arts, e.g. History, Languages
   - ☐ Social Sciences, e.g. Politics, Geography, Economics

7. **How often do you play video games (console, computer, or smartphone)?**
   - ☐ Never
   - ☐ Infrequently (once every couple of months)
   - ☐ Sometimes (once a month or so)
   - ☐ Weekly
   - ☐ Daily

8. **What genre(s) of games do you play? Check all that apply:**
   - ☐ I don’t like playing video games of any sort.
   - ☐ RPG (Role-Playing Game), e.g. Final Fantasy, Dragon Quest
   - ☐ Fighting, e.g. Mortal Kombat, Street Fighter
   - ☐ Shooters (FPS or First-Person Shooters), e.g. Call of Duty
   - ☐ Puzzle, e.g. Bejeweled, Candy Crush, Tetris
   - ☐ Strategy, e.g. Civilization, StarCraft

- ☐ MMOs (Massively Multiplayer), e.g. World of Warcraft, Final Fantasy Online
- ☐ Adventure, e.g. Myst, King's Quest
- ☐ Platformers, e.g. Super Mario Bros.
- ☐ Sports, e.g. NFL, racing games
- ☐ Sandbox, Open World, or Simulation, e.g. the SIMs, Minecraft
- ☐ Horror or Survival Horror, e.g. Silent Hill, Five Nights at Freddy's
- ☐ Stealth, e.g. Metal Gear Solid, Thief

Your Enjoyment of the Class:

9. Rate your level of enjoyment with this course so far:

Very Enjoyable	Enjoyable	Neither	Not Very Enjoyable	Not Enjoyable At All
1	2	3	4	5

10. This course didn't hold my attention at all.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

11. In the last month, I've been happy taking this class.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

12. I think this course is boring.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

13. The structure of the course has encouraged me to research and learn about related content that I might not have otherwise explored.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

14. I feel that the course structure adds unnecessary complexity to the course, which has distracted me from my studies.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

15. **In the last month, I've put in more effort in this course than in most of my other courses.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

16. **In the last month, I've put forth less effort in this course.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

Specific Gamification Elements:

17. **I don't enjoy working on guild/team tasks.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

18. **Levelling up in this course makes sense to me.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

19. **I want to get to the top level.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

20. **I don't care about levelling up.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

21. I like the solo tasks best.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

22. I find the weekly challenges and/or presentations useful for remembering course content.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

23. The weekly challenges and/or presentations encourage me to participate with other students.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

24. The weekly challenges and/or presentations encourage me to participant more in class than I usually would.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

Grades anD Perceived Performance:

For ITM445:

25. I prefer the XP structure for grades used in this course to the way grades are calculated in my other courses.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

26. Getting XP for weekly theory and practical challenges made me do more of the class work for this course than my other traditionally-run courses.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

27. I found the XP structure used for grades in this course condescending.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree

1	2	3	4	5

28. **I checked my XP status for this course more often than I checked my grade status in other courses.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

29. **Getting weekly XP encouraged me to turn up to class.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

For CMN450:

25. **I would prefer using the XP structure in place of traditional grades.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

26. **Getting XP for weekly theory and practical challenges made me do more of the class work for this course than my other traditionally-run courses.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

27. **I found the XP component of this course condescending.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

28. **I checked my XP status for this course more often than I checked my grade status in this and other courses.**

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree

1	2	3	4	5

29. Getting weekly XP encouraged me to turn up to class.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

30. I only do extra weekly exercises and study if I know that it contributes directly to my grade.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

31. I'm only interested in passing the course. A higher grade would just be a bonus.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

32. I want to get the highest grade possible.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

Overall Impression of the Course Style:

33. I <u>do not</u> want to take more courses like this one.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

34. I <u>want</u> to take more gamified courses.

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

35. What do you like about the gamification elements?

36. What do you dislike about the gamification elements?

37. How could the gamification elements be improved?

Appendix B

Example of Challenges for CMN 450

It's time to learn about infographics. Your tasks, if you choose to accept them, are as follows: (6 EP)

- Find a few infographics on one term from the Social Media Glossary
- From the definition create your own infographic. YOU MUST do outside research
    - Must include 1 statistic
    - Have to include the definition
    - Must be visually appealing (not over crowded)
- Post your infographic to Facebook with a 50 word description

It's time to learn about infographics. Your tasks, if you choose to accept them, are as follows: (8 EP)

- Find a few infographics on one term from the Social Media Glossary
- From the definition create your own infographic. YOU MUST do outside research
    - Must include 2 statistics
    - Have to include the definition
    - Must be visually appealing (not over crowded)
- Post to your customized blog with a 100 word description

It's time to learn about infographics. Your tasks, if you choose to accept them, are as follows: (10 EP)

- Find a few infographics on one term from the Social Media Glossary
- From the definition create your own infographic. YOU MUST do outside research
    - Must include 2 statistics
    - Have to include the definition
    - Must be visually appealing (not over crowded)
- Post to Twitter or Google+ with an 80 character explanation of what you are posting.

It's time to learn about infographics. Your tasks, if you choose to accept them, are as follows: (12 EP)

- Find a few infographics on one term from the Social Media Glossary
- From the definition create your own infographic. YOU MUST do outside research
    - Must include 2 statistic
    - Have to include the definition
    - Must be visually appealing (not over crowded)
- Cut up the infographic into maximum 6 equal square images and post on Instagram
    - Include a 50 character explanation for each image
    - Make sure each image could stand alone without an explanation

Now that you have access to podcasting let's create a podcast! Your takes, if you choose to accept them, are as follows: (15 EP)

- Pick three terms from the Social Media Glossary and create a 2-3 minute podcast explaining the terms
    - Do not just state the definition! Do some research and include at least one example of how the term is used in the context of social media
- The podcast should include transitions between terms and three separate tem members voices (one per term)
    - This will require you to edit some audio!
- You must upload the podcast to somewhere with a sharable link (google drive will work)

Your next quest, if you choose to accept it, is the following: (4 EP)

- Find two infographics that explains the demographic breakdown of Facebook
- Post both infographics to your Facebook page as curated posts
    - Explanation must be minimum 100 words.

Your next quest, if you choose to accept it, is the following: (6 EP)

- Find three infographics on blogging

- Post both infographics to your blog with explanations on what information they are telling you.
  - Explanation must be minimum 150 words.

Your next quest, if you choose to accept it, is the following: (8 EP)
- Find four infographics that explains the demographic breakdown of Twitter of Google+
  - Must be a breakdown for the network you will post to (if you post to Twitter they must be for Twitter)
- Post both infographics to your Twitter or Google+ page as curated posts
  - Explanation must be maximum 100 characters plus link.

Your next quest, if you choose to accept it, is the following: (10 EP
- Create a 1 minute podcast that explains something you learned in class today
  - Can be from the student presentation, lecture, or the readings for the class
- Must indicate where you learned it from such as…when the group presented we….
- You must upload the podcast to somewhere with a sharable link (google drive will work)

Example of Challenges for ITM 445

State of the Art Challenge

Unscramble These Words

trfiaeenc

dmeayihrpe

asiilubyt

fnitucytoailn

lsyiptciim