

Effectively Acquiring and Demonstrating Spreadsheet Proficiency

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Abstract

This paper conveys the story of the efforts by an information technology department to prepare students to demonstrate spreadsheet proficiency both in the classroom for quantitative assignments, and to meet internship and future career requirements. A foundational problem to be solved was how to motivate students to acquire additional competency with spreadsheets. This is a story that highlights the value of a synergistic cooperation among practitioners, publishers and academic professionals. The increased proficiency demonstrated by our students who successfully complete professional certification workshops facilitates a seamless integration of spreadsheet add-ins needed to support the learning objectives in more advanced business courses.

Keywords: spreadsheets, certification, business analytics

1. INTRODUCTION

Our business school has responded to a pervasive and increasing market demand for undergraduate and graduate courses in business analytics. The quantitative rigor of the analytics courses refocused our efforts to effectively provide our students with a proficiency with spreadsheets. Even a casual review of the relevant published research establishes two important facts. First, acquiring data analytics knowledge requires spreadsheet technology skills (Jafar, Babb, & Abdullat, 2016). Second, there is a lack of consensus regarding exactly how to provide these skills. (Formby, Medlin & Ellington, 2016).

He (2011) reports on research that attempted to enhance rudimentary Excel skills in an undergraduate operations management class without compromising the time required to cover the necessary subject-matter content. He concluded that the best approach involved utilizing homework assignments with specific Excel instructions rather than Excel lectures or general-purpose Excel instructions.

Rubin and Abrams (2015) warn that students entering university lack the necessary computer skills to succeed in quantitative analysis courses, in which they are often expected to input data, analyze, and plot results without any previous formal experience with Microsoft Excel or similar spreadsheet programs. Moreover, generic spreadsheet tutorials are not subject matter specific enough to be useful. They concluded that an interactive lab produced the best success for classwork assignments and future careers. More generally, DiMaria-Ghalili & Ostrow (2009) concluded that Excel skills effectively incorporated in the academic context could produce useful professional skills.

A recent study of the expectations of employers regarding technological proficiencies of business school graduates suggested a wide gap between students' perceptions of their skill levels and their actual proficiencies (Bingi, Karim, & Rassuli, 2013).

This paper tells the story of the efforts by an information technology department to prepare students to demonstrate spreadsheet proficiency both in the classroom for quantitative

assignments, and to meet internship and future career requirements. It is a story that highlights the value of cooperation between practitioners and academic professionals. An important the limitation of this story is its reliance on anecdotal evidence. In his essay included in "This Idea Must Die: Scientific Theories That Are Blocking Progress," Nicholas Carr tries to rehabilitate the anecdote.

2. CORE COURSE CONTENT

Curriculum design decisions made by our business school in the 1990s resulted in the requirement that sophomores take a 3-credit core course (ITEC 200) to acquire competency in a broad range of information technologies used in the modern workplace. Course topics are reinforced via hands-on assignments that use information systems applications such as spreadsheets, databases, and web-based tools. Because spreadsheet competency is essential for building models and solving problems in finance and accounting, this course is a required prerequisite to all subsequent quantitative courses in accounting, analytics and finance.

Our operations management course topics include predictive models and optimization scenarios that rely on spreadsheet add-ins such as Solver. More recently, the addition of business analytics courses and programs has created the need provide tool support to mine data to find patterns or relationships using both unsupervised learning techniques and supervised learning techniques. Furthermore, analytics students need tools that enable them to formulate and solve optimization models for problems with linear, integer, and nonlinear components. The data visualization requirements to obtain analytics insights require skillful use of advanced tools with charting functionality (e.g., parallel coordinate plots, tree maps, and data dashboards) available via Excel add-ins such as XLMiner and Analytic Solver Platform.

Which Spreadsheet?

Most rankings consider Microsoft Excel as the top choice in spreadsheet software for businesses, but many experts acknowledge the value of free, open source products such as LibreOffice Calc; while other prefer Google Sheets for its simplified user interface and collaboration support. Our information technology department resides in the business school, and so Excel was the obvious choice as the required spreadsheet application. A subsequent decision by the university to adopt Office 365 bolstered this choice.

In response to overcrowding of the computer labs, our business school requires all students to have a personal laptop for use during classes. Students are provided a license for Office 365 Pro Plus, which is required for all quantitative assignments. This application software, includes Excel, but operates only in a Microsoft Windows operating environment, so Apple Macintosh users are required to partition their hard disk and install the Windows operating system in a second partition. Generally speaking, Excel versions for Apple Macintosh and Microsoft Windows operating systems are reasonably compatible, but the differences become increasingly significant with more advanced tasks.

3. NOT ENOUGH EXCEL

Clayton & Sankar (2009) established that student use of spreadsheets for problem solving enhanced motivation and learning. Feedback from our business school faculty in higher-level quantitative courses suggested that the coverage of spreadsheet skills and knowledge provided in our single prerequisite ITEC 200 course was inadequate. This concern was reinforced by internship coordinators and career center advisors.

Of course, no consensus emerged from attempts to remove a course from the curriculum to make room for an additional quantitative tools course. Faculty also resisted the suggestion of revising courses to embed more instruction about spreadsheets because it would compromise the time available to cover the subject-matter content. Encouraging students to utilize online courses and tutorials, such as Lynda.com, resulted in no improvement in competency. So, the problem to be solved was how to motivate students to use an elective course to acquire additional competency with Microsoft Excel.

Practitioner Solution

Our department has a long history of demonstrated successful innovation resulting from a collegial blending of ideas from practitioners and academic professionals. During the 2008-2009 academic year, we were fortunate in having an adjunct instructor who had previously worked as a senior director in Microsoft's Higher Education Strategy & Programs area. She convinced the academic scholars leading our department of the value of professional certification for our students. Before leaving our university in 2010, she proctored my certification exams and trained me to serve as an exam proctor and test center administrator.

Since then, whenever the test environment or practice exams are updated, all of us involved in the administration or delivery of certification exams or learning products attend all applicable training sessions in account management, the exam platform (Certiport's Console 8) and the practice exams (GMetrix).

Certiport® provides computerized test delivery software and services and conducts an annual educator conference. Our business school had invested in a state-of-the-practice financial services and information technology computer lab with facilities that met the Certiport Authorized Testing Center policies, guidelines, procedures and technical requirements. It was a bit of a challenge to evaluate the technical requirements of administering a Certiport exam against our computer, software and network setup to ensure a seamless integration that supports an error-free testing environment.

At the start of each academic year, we renew our agreement with Certiport, pay the practice test license fees and purchase certification exam vouchers for the students. When students enroll in the certification weekend workshops they pay an extra fee (\$60) to cover the exam voucher. As an authorized testing center, we conduct a workshop that concludes with the administration of the certification exam in our 38-seat computer lab. The 50-minute exam is proctored and results are displayed immediately after the exam is submitted.

Microsoft Office Specialist (MOS, previously Microsoft Certified Application Specialist) certification exams are proctored exams and must be taken at a Certiport Authorized Testing Center. Microsoft's certification overview website explains that the Office Specialist certification is for those individuals who are looking to demonstrate proficiency in one or more Office programs. Those who pass the exam will receive (by mail) an official certificate within approximately 2 to 3 weeks. Certiport, as the exam delivery provider, also maintain a database of transcripts and exam results. It should be noted that there are certifications other than Microsoft Office Specialist.

The value of certification is still being debated in the research literature. How Microsoft handles certification preparation and testing impacts the general debate about the value of certifications and the effectiveness of the actual exam questions. Microsoft establishes the scoring algorithm and cut score (currently 700 out of

1000 possible points). If Microsoft makes its exams too easy or possible to cheat on, its certificates will be devalued, which does irreparable harm to technology certification in general. Conversely, if the exams are too hard, they may become less accurate representations of real-world needs and encourage people to seek out the wrong methods to help them pass, or simply abandon the idea.

Any change to the Microsoft Excel application package, as part of the Microsoft Office suite of tools, forces a change to the associated certification exam and preparation materials. It is noteworthy that these functional updates to content are utilized by Microsoft to continuously make improvements to the certification exam format to better simulate real-world scenarios. For example, project-based (rather than item-based) exam tasks first introduced for the MOS 2013 exams provided, for the first time, realistic, industry-leading assessments of skills and knowledge to more accurately appraise how Excel would be actually used. The MOS 2016 exam format incorporates multiple, smaller projects and changed the task instructions to avoid command and function names, requiring a deeper understanding of program functionality. The use of multiple smaller projects, rather than one large project allows more objective domains to be incorporated.

4. ACQUIRING PROFICIENCY

Leveraging the products developed by Microsoft and Certiport, we developed a one-credit elective workshop (ITEC 477), which was piloted with a single section in each semester of the 2008-2009 academic year. The course syllabus explains that this is designed to be a hands-on workshop with a single course learning objective: help students acquire the additional skills and knowledge needed to successfully complete the Microsoft Excel certification exam. The course was designed so that students use practice tests to gain an understanding of the certification exam format and content. The instructor monitors the practice sessions and is available to provide each student with additional explanations and suggestions for further study of the more difficult tasks.

It is important to note the availability of the practice exams and interactive exercises supplements, rather than replaces, the craft of teaching, which remains vital for effective learning. Students have the opportunity (and motivation) to ask the instructor deeper

questions about when and why to use a function instead of just how.

Course grades are limited to Pass/Fail, and are not calculated in the student’s grade point average. A two-day weekend schedule (9 am to 4 pm on Saturday and Sunday) was adopted initially to overcome computer lab availability constraints. Later, we realized that the concentrated weekend format facilitated better recall of some of the exam content. Table 1, below provides details of the course offerings and certification exam pass rates to date.

Of course, we must be careful not to claim that higher pass rates on the certification exams are evidence of higher proficiency. Another important consideration is the likelihood of self-selection bias in that this elective course would tend to attract students that are already proficient in Excel.

Academic Year / Excel Version	# Students	Pass Rate
2008-2009 Excel 2003	37 Pilot	92%
2009-2010 Excel 2007	138	73%
2010-2011 Excel 2007	126	86%
2011-2012 Excel 2007	145	84%
2012-2013 Excel 2010	186	90%
2013-2014 Excel 2010	202	86%
2014-2015 Excel 2010	193	89%
2015-2016 Excel 2013	181	89%
2016-2017 Excel 2016	164	90%

Table 1: Certification Exams Offered

In the interest of security, Certiport distributes multiple versions of its exams, each with different content and number of assigned tasks to complete. However, steps are taken to ensure that each version of an exam measures and certifies an equivalent level of knowledge, skill, and ability. For each exam, passing standards are derived from a combination of expert opinion on “minimal competence” and observations regarding how well an exam differentiates between low-performing and high-performing examinees. Certiport maintains summary statistics regarding each exam, including pass/fail rates, and provides a breakdown, by category, of

performance of each test candidate. To reinforce the commitment to promote certification rather than just test success, the actual scoring of individual questions and overall scoring algorithm is not published.

Textbook Evolution

In 2008 our computer lab was still configured for Excel 2003. The first textbook chosen was *Excel 2003: The Missing Manual* (a 792-page reference). This low-cost text was selected because, as stated in the introduction, it “...shows you how to use Excel’s tools to answer real-world questions like “How many workdays are there between today and my vacation?”, “How much money do I need in the bank right now to retire a millionaire?” (MacDonald, 2004).

Course content topic selection was initially based on the short list of topic categories published by Microsoft. For the 2007 exam, this succinct list of skills to be measured included: “create and manipulate data, format data and content, create and modify formulas, present data visually, collaborate on and secure data”. Later course revisions took into consideration research such as reported by Ragland and Ramachandran (2014) who found that employees at the firms believe the most important Excel functions are: basic formulas, filtering and sorting data, vertical lookup from tables, formatting of documents, and conditional (if-then) statements. In a comparison of new hires at public accounting firms with accounting students, their results suggest that students underestimate the importance and usage of some of these Excel functions. In addition, results suggest that new hires perceived knowledge on how to use specific Excel functions in their job is statistically different than students perceived knowledge on how to use some of the same Excel functions.

REVIEW BEFORE THE WORKSHOP WEEKEND - We assume that you have been working with Excel 2007 for at least six months and that you know how to carry out fundamental tasks.		
Chapter	Title	Pages
Chapter 1	Creating and Navigating Worksheets	21 – 56
Chapter 2	Adding Information to Worksheets	57 – 74
Chapter 4	Managing Worksheets and Workbooks	95 – 104
Chapter 17	Creating Basic Charts	463 – 495

Table 2: Syllabus Pre-class Assignments

For the three years that we conducted the course using Excel 2007, the course assignments were constructed as shown in tables 2 and 3 below.

COMPLETE DURING THE WORKSHOP WEEKEND		
Chapter	Title	Pages
Chapter 3	Moving Data Around a Worksheet	75 – 94
Chapter 5	Formatting Cells	119 – 152
Chapter 6	Smart Formatting Tricks	153 – 184
Chapter 7	Viewing and Printing Worksheets	185 – 218
Chapter 8	Building Basic Formulas	219 – 252
Chapter 9	Groups of Numbers	259 – 264
Chapter 11	Manipulating Text	309 – 311
Chapter 12	Advanced Lookups	331 – 336
Chapter 13	Descriptive Names for Cell References	358 – 375
Chapter 14	Tables: List Management Made Easy	393 – 423
Chapter 15	Grouping and Outlining Data	427 – 442
Chapter 18	Formatting and Perfecting Charts	497 – 517
Chapter 19	Inserting Graphics	537-565
Chapter 22	Data Validation	628 – 637
Chapter 23	Worksheet Collaboration	649 – 676

Table 3: Syllabus In-class Assignments

During this time, using this approach to learning, students who attempted to shortcut the learning process by only working with practice exams and taking only a cursory look at the textbook usually failed the certification exam.

As Excel functionality has increased with newer versions (i.e., 2010, 2013, 2016) the course approach has evolved from using a printed textbook to incorporate an interactive e-book. While considering the plethora of books and websites that offer the opportunity to learn Excel, we discovered that Wiley Higher Education had partnered with Microsoft to create a *Microsoft Official Academic Course* series, which is a complete program to prepare and deliver effective courses focused on Microsoft software technologies.

WileyPLUS combines an interactive e-book with a web-based assignment and assessment tool. The Wiley text provides detailed Excel syntax instructions, along with screen snapshots and certification tips. It is a complete package that includes a test bank, project data files, instructor guides, and PowerPoint lecture slides. The practice exercises include both task-based and project-based formats.

The ability to pair the Wiley test with our learning management system portal (BlackBoard) allows instructors to verify student completion of pre-class assignments and to track in-class progress in real time. WileyPLUS Overview Knowledge Assessment (Practice) Questions for all chapters are due prior to the start of the weekend workshop. Additionally, WileyPLUS Testbank Assignments for all chapters are to be completed during the weekend workshop. The GMetrix practice exams are also completed during the weekend workshop.

Microsoft certification exams for earlier versions of Excel, Access and PowerPoint provided a variety of brief tasks to complete using application tools and functions. The new exam format for Microsoft Office 2013 presents the candidate with a small project to build, with tasks and steps that build on each other. To better prepare students for the new exam format this ITEC 477 course was redesigned to use the *Microsoft Excel 2013, Exam 77-420* e-book, which (as the title suggests) is mapped directly to the Excel 2013 certification exam objectives and is also designed to bolster workforce skills. With this book students learn to create and edit professional-looking spreadsheets for a variety of purposes and situations. It also covers such skills as charting, creating analytical, financial reports, data entry, developing budgets, formatting numerical (financial, statistical, etc.) reports, creating forms, graphing, processing data, reporting, technical support, and trending.

Last summer, we upgraded the computer lab to support Excel 2016. To date, neither Wiley nor any other publisher has crafted a textbook that so perfectly aligns with the certification exam content. Fortunately, the actual functional changes from Excel 2013 to Excel 2016 are relatively minor and, as noted in table 1 above, our certification exam pass rate remained stable at around 90%.

Practice Software Evolution

For Excel 2003 and 2007, two slightly different exam preparation software packages were available: MeasureUp and Certiprep. These

packages provided a small test bank of tasks similar to those presented on the actual certification exam. Students performed each task individually and received a binary evaluation of their performance (green checkmark or red X) upon submission. Incorrect attempts could be retried and a help feature was available. These practice tests were useful for introducing students to the exam look and feel, but did not provide adequate coverage of the full scope of exam content expectations. For later versions of Excel (2010, 2013, 2016) GMetrix is the preferred provider of practice exams.

The efficacy of the practice exams as preparation for the actual certification exams can be attributed to their design, which simulates Microsoft's "live-in-the-application" look and feel, which incorporates a fully functional Excel workbook and the exam task on each screen (see Figure 1 below).

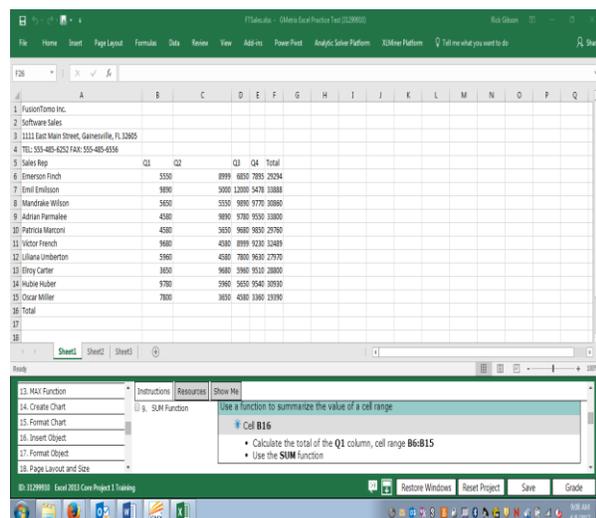


Figure 1: GMetrix Practice Exam Example

These exams are continually updated and the latest versions (for Excel 2016) provide six different practice exams, which requires six to eight hours to complete.

Finally, it should be noted that Microsoft offers an Excel Expert certification that builds on the core concepts to include advanced formulas, macros, security and formula debugging. We only offer one small section of the Excel Expert workshop per semester, and proficiency results from these small samples are, so far, inconclusive.

5. SUPPORT FOR CERTIFICATION

The decision by our department to incorporate certification to motivate students to acquire and

demonstrate spreadsheet proficiency was, quite frankly, a practitioner inspired pilot experiment that succeeded beyond our expectations. Nevertheless, significant scholarly support is emerging. Gomillion (2016) analyzed survey results and concluded that industry certifications have value in that they can signal "real-world skills" to employers, and possibly serve as a "tie-breaker" when otherwise equally qualified candidates apply for a position.

Elrod, Pittman, Norris & Tiggeman (2015) noted that use of spreadsheets for analysis of data, calculations, and financial analysis is among the skill sets tested on the CPA examination. They conducted an experiment with third year accounting students in which the treatment group was training using a Microsoft Excel certification program, in addition to accounting classes. Their control group received no special spreadsheet training. Pre- and post-tests of Excel skills allowed them to reject the null hypothesis of no difference in test scores at the 10% level of significance, which allowed them to conclude that extra emphasis on spreadsheets through certification programs of this kind may be helpful in meeting student learning outcomes.

6. BEYOND EXCEL CERTIFICATION

Our initial venture into professional certification was driven by an awareness that students were unable to adequately demonstrate spreadsheet proficiency either in the classroom for quantitative assignments, or to meet internship and future career requirements. More recently, we are reexamining this approach in terms of the market demand for undergraduate and graduate courses in business analytics. The increased proficiency demonstrated by our students who successfully complete the certification workshops facilitates a seamless integration of Excel based add-ins needed to support the learning objectives in analytics courses. For example, here are the learning outcomes for one of our introductory courses in the business analytics program:

- By the end of this course, students will be able to:
1. Define business analytics, the three categories of techniques (descriptive, predictive, prescriptive), and the analytics cycle.
 2. Visualize data using tables and a variety of charts that are available in commercial software such as XLMiner and Excel.
 3. Develop forecasting models for data with trend and seasonality using moving averages, exponential smoothing, double exponential smoothing, and multiple regression.

- Mine data to find patterns or relationships using both unsupervised learning techniques and supervised learning techniques.
- Formulate optimization models for problems with linear, integer, and nonlinear components and solve these models with commercial software such as Excel Solver and Analytic Solver Platform.
- Develop multi-objective decision models for problems in which subjective preferences of the decision maker(s) must be quantified.

The textbook selected for this course (Camm, et al.) provides excellent tutorials with applied analytics examples using the Excel add-ins, but assumes prerequisite knowledge of core Excel functionality.

FrontlineSolvers® provides analytics tool add-ins that work with an Excel platform. Their Analytic Solver product supports simulation, optimization and data mining tools to support predictive and prescriptive analytics. Additionally, the multivariate data visualization features support creation of parallel coordinate plots, scatter chart matrices, tree maps and data dashboards.

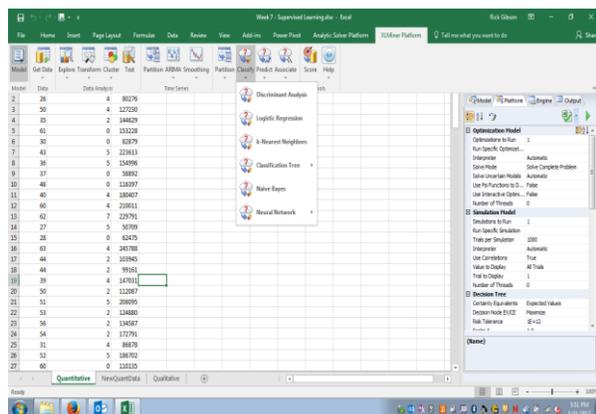


Figure 2: Screenshot of Excel with Add-ins

Without a solid understanding of core Excel functionality, students can neither appreciate nor effectively use the advanced features of the Excel add-ins for business analytics tasks. It should be noted that Excel's current limits of 1,048,576 rows by 16,384 columns may not support some aspects of "Big Data" that are central to a complete business analytics program.

7. CONCLUSION

Spreadsheet proficiency is solidly entrenched as a foundational skill for information systems education. As educators, we must not only keep up-to-date with the software tool evolution, but

we must also implement ways to keep our courses relevant and exciting.

Fortunately, at least in terms of Excel spreadsheets, the synergistic efforts of business entities such as Microsoft, GMetrix, Certiport and Wiley provide a performance-based approach for learning that results in a tangible demonstration (i.e., certification) of acquired skills and knowledge that students are intrinsically motivated to accomplish.

In closing, it is important to remember Carr's (2015) observation that if we use a tool (e.g., a calculator or spreadsheet) to bypass learning, to carry out procedures that we haven't learned and don't understand, the tool will be a barrier to higher thought. By providing our students with spreadsheet proficiency, we enable the insights that are the purpose of business analysis.

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