The Effect of Competence-Based Simulations on Management Skills Enhancements in E-Learning Courses

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Abstract

There is a growing interest in the assessment of tangible skills and competence among higher education in the United States. Specifically, there is an increase in the offerings of competency-based assessments, and some academic institutions are offering college credits for individuals who can demonstrate adequate level of competency on such assessments. An increased interest has been placed on competence-based computer simulations that can assist learners in traditional and online-courses to gain tangible skills. There has been an acceptable instrument used to measure a set of 12 management skills, as part of business and management courses. While computer simulations and competency-based projects, in general and in management in particular, have demonstrated great value, there are still limited empirical results on their impact in online learning courses. Thus, we have developed a quasi-experimental research, using such instrument on pre- and post-tests, to collect the set of 12 management skills from online learners attending courses that included both competence-based computer simulations and those that didn't. Our data included a total of 253 responses. All 12 management skill measures demonstrated very high reliability, results consistent with prior literature. Our results indicate that all 12 skills of the competence-based computer simulations had higher increase than those that didn't. A t-test on the mean increases indicated an overall statistically significant difference for six of the 12 management skills enhancements between the experimental and control groups. Our findings appear to demonstrate that overall computer simulations and competency-based projects do provide added value when it comes to management skill enhancements.

Keywords: competency-based projects in online learning, simulations in online learning, managerial skills enhancements, management skills in online learning, self-reported skills.

Introduction

Recently, Competency Based Learning (CBL) has been debated in higher education and professional development training, including in for-credit professional re-certification courses. According to the U.S. Department of Education, CBL enables learners to "master academic content regardless of time, place, or pace of learning" (US Department of Education, 2013). Such programs include "online and traditional courses, dual enrollment and early high schools, project based and community based learning, and credit recovery (i.e. Diploma Plus)" (US Department of Education, 2013). Moreover, this strategy employs various teaching methodologies, while providing learners with the credits for the learning opportunities gained via lifelong experiences or other means by demonstrating adequate skill levels (i.e. competence) (Hyman, 2012). Learners can access preferred learning methodology that provides them with academic experience to develop and enhance specific skills needed to support their working careers. For example, the ability to make good decisions when faced with complex situations,

the ability to research information in order to identify a solution set, the ability to set goals and work towards achieving the goals, as well as the ability to communicate well, are all skills needed in a number of organizations. Subsequently, learners can assume positions with little training on the job, and greater confidence (Gravill, Compeau, & Marcolin, 2006). CBL strategy can deliver greater flexibility, efficiency, and lower costs to learners, while at the same time, cultivating greater employability. Indeed, companies appear to demand incoming employees to be competent on the job, when coming with academic degrees (Piccoli, Ahmad, & Ives, 2001). As such, hiring managers expect that academic programs will prepare their graduates with the right skills set that can be applied upon hiring (Lee & Mirchandani, 2010; Torkzadeh & Lee, 2003). For example, in the medical and health professions, a significant part of academic courses is devoted to skill enhancements (Berendonk, Stalmeijer, & Schuwirth, 2013). Moreover, the emphasis in medical programs is to develop, as well as enhance, the "skills and qualities doctors need to have to care for patients" (Morcke, Dornan, & Eika, 2012, p. 856). According to Boyatzis and Kolb (1991), a skill refers to a "combination of ability, knowledge and experience that enables a person to do something well" (p. 280). Thus, when medical and health professionals (i.e. surgeons, physicians, nurses, therapists, etc.) graduate from their academic degree program, they are required to demonstrate the skills that they have learned during their academic experience. That high-level of demonstrable skills (i.e. competency) is excepted for certification and licenses (Bronsburg, 2011; Morcke et al., 2012). Beaudoin, Kurtz, and Eden (2009) introduced a definition based on prior literature that claimed competencies to be "a specialized system of abilities, proficiencies, or dispositions to learn or do something successfully, or to reach a specific goal, prerequisites for meaningful activities and which are influenced through experience and learning" (p. 277). In order to demonstrate the linkage between skills and competencies, Figure 1 highlights the relationship between the two (i.e. skill level & competency level), while providing a theoretical framework for this study.

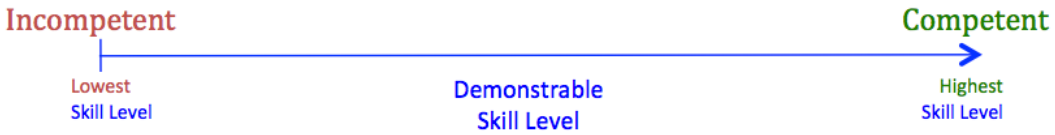

Figure 1. Relationship Between Skill Level and Competency Level

In some academic fields, such as medicine and engineering, the focus is almost exclusively on academic knowledge transfer for the purpose of skills development (i.e. "what we *need* students to *demonstrate* they know"). In other academic fields such as management, including information systems, a significant number of academic institutions appear to focus on academic knowledge transfer, for the purpose of content delivery and learning outcomes (i.e. "what we *want* students to know"), and less on skill development that is so crucial for employability (Compeau & Higgins, 1995; Kayworth & Leidner, 2000). Having said that, computer simulations and competency-based projects have a significant role in helping learners hone such skills. In general, while their use is not widespread as in other fields, computer simulations and competency-based projects have demonstrated great value in management education (Keys & Wolfe, 1990; Noy, 2014; Noy, Raban, & Ravid, 2006). Furthermore, research studies have demonstrated that computer simulations and competency-based projects can indeed assist in providing students with achieving fundamental skills that are needed upon graduation (Keh et al., 2008; Koh et al., 2010). The aim of CBL is to create various paths to college education, while taking advantage of innovative information system technologies not as part of traditional in-class education but rather as an online skills enhancement tool by itself. Specifically, over the past several years there has been a growing use of free and open tools such as: YouTube, iTuneU, online courses, Web 2.0, Massively Open Online Courses (MOOCs), digital books, and digital notes. While a significant number of research studies have been done on the benefits of computer simulations as a skill development tool, the majority of such studies have focused on using the tools as part of a face-to-face course or to augment traditional learning modalities. However, there is a very limited number of research studies that have been conducted on the measurements of skill enhancements in fully online courses and programs, as opposed to

measuring the benefits of such computer simulations as well as competency-based projects to augment in-class courses (Levy, 2005). Additionally, there are still limited empirical results on the use of computer simulations and competency-based projects being used as part of fully online learning courses. Thus, in this paper we have developed a quasi-experimental research using such instrument on pre- and post-tests to collect the set of 12 management skills from learners attending fully-online courses, including competence-based computer simulations and those that didn't. Therefore, the main research question guiding our study was:

RQ: What is the effect of *computer simulations and competency-based projects on management skills enhancement* in online learning courses?

Methodology

Boyatzis and Kolb (1991, 1995) have developed a self-reported instrument to measure 12 management skills that pertains to businesses and are expected from student graduating from management programs. Specifically, the core use of their measures was to compare the enhancements of skills over an academic experience, be it a course or a full program, where students are engaged in skill enhancements activities. Given that management skills are challenging to measure, scholars in the field agree that self-reported skill level assessments are acceptable and indeed one of the ways to know what an individual feels about their own competence level (Gravill et al., 2006). As such, we have developed a study to collect the set of 12 management skills using a 36-item instrument (three items per skill) from online courses that included computer simulations compared with a control group of those that didn't experience the simulations, but were in other sections of the same management courses. This study was designed as a quasi-experiment, given the fact that we had no control over the assignment of participants to the groups (Levy & Ellis, 2011). The control group included: one course in Project Management in the undergraduate level and one course in Management Information Systems at the graduate Masters of Business Administration (MBA), distributed about equally. The experimental group included: two courses in Project Management in the undergraduate level and two courses in Management Information Systems at the graduate MBA, distributed about equally. Data was collected during the 2012-2013 academic year (summer included). The same professor taught all courses fully-online, however, given adjustment in accreditation and/or course objective requirements, computer simulations were introduced. The control group included the content covered in a regular e-learning fashion: weekly discussion board assignments, quizzes on chapter readings, current event papers, as well as a final exam. The experimental groups included: online simulation via WileyPLUS (https://www.wileyplus.com/) of an SAP® Enterprise Resource Planning (ERP) project for the graduate MBA students, and the use of Microsoft Project™ 2010 to develop a project documentation report with Work-Based Structure (WBS), budget planning, resource allocation, as well as the project's Gant chart for the undergraduate students. We developed a Web-based instrument to assess the 12 management skills along with some demographics information to ensure the groups are relatively similar. Each group of students was asked to take the survey at the start of the term, and then asked to take it again at the end of the 16-week[1] term.

Results

A total of 253 surveys have been collected over the four groups (pre-test control group, pre-test experimental group, post-test control group, & post-test experimental group). Table 1 provides the descriptive statistics and gender distribution of the learners participated in all four groups. We have attempted to ensure that those who have taken the pre-test also will complete the post-test, however, given the nature of the quasi-experiment and real-life settings, a few students either dropped or elected not to further participate in the post-test survey, which explains the drop in the post-test sample size.

1 The Fall and Winter terms were 16 weeks long, but the Summer term was 14 weeks long.

Table 1. Descriptive Statistics and Demographics of Learners

		Control Group		Experimental Group	
Test	**Gender**	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
Pre-Test	Female	21	42.0%	37	44.0%
	Male	29	58.0%	47	56.0%
		50		84	
Post-Test	Female	21	42.9%	31	44.3%
	Male	28	57.1%	39	55.7%
		49		70	

As part of the data analysis, we have verified the reliability of the 12 management skills using Cronbach's Alpha (Cronbach, 1951). Alpha levels of 0.7 and above have been reported to indicate strong reliability for the constructs (Boudreau, Gefen, & Straub, 2001; Straub, 1989). Table 2 provides the outcome of this analysis, which suggests that all 12 skills demonstrated very high reliability ranging from Cronbach's Alpha of 0.835 to 0.955.

Table 2. Cronbach's Alpha Reliability Analysis for the 12 Management Skills Measures

Management Skills	No. of Items	Cronbach's Alpha
Help Skills (HLS)	3	0.835
Adapting Skills (ADS)	3	0.898
Planning Skills (PLS)	3	0.870
Information Gathering Skills (IGS)	3	0.853
Information Analysis Skills (IAS)	3	0.899
Quantitative Skills (QNS)	3	0.916
Technology Skills (TCS)	3	0.952
Goal-Setting Skills (GSS)	3	0.955
Action Skills (ACS)	3	0.886
Initiative Skills (INS)	3	0.919
Leadership Skills (LSS)	3	0.952
Relationship Skills (RES)	3	0.920

Prior to investigating the skill increase, a t-test for all 12 management skills was conducted to check if the pre-test of both groups is similar (Terrell, 2012). Our findings indicate that 10 out of the 12 skills were not significantly different on the pre-tests between the experimental and control groups (p ranged from 0.329 to 0.896), aside from the LSS and RES, which were slightly lower p-values ($p_{LSS} = 0.018$ & $p_{RES} = 0.053$) for the pre-test of the control group compared to the pre-test of the experimental group. Figure 2 provides the star-graph view for the 12 management skills on the pre- and post-test for the control group.

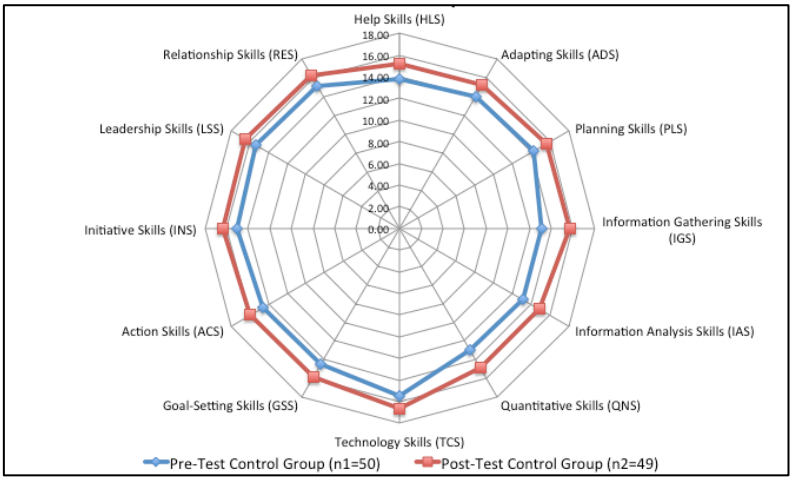

Figure 2. The 12 Management Skills for Pre- and Post-Tests Control Group ($n_1 = 50$, $n_2 = 49$)

Moreover, our t-test results indicate that although the overall management skills mean total for the pre-test control group was slightly higher than the mean total for the pre-test of the experimental group (171.52 vs. 164.29), the experimental group demonstrated a significant ($p < 0.001$) enhancement of the total management skills in the post-test compared to the control group (189.05 vs. 197.85). Figure 3 provides the star-graph view for the 12 management skills on the pre- and post-tests for the experimental group.

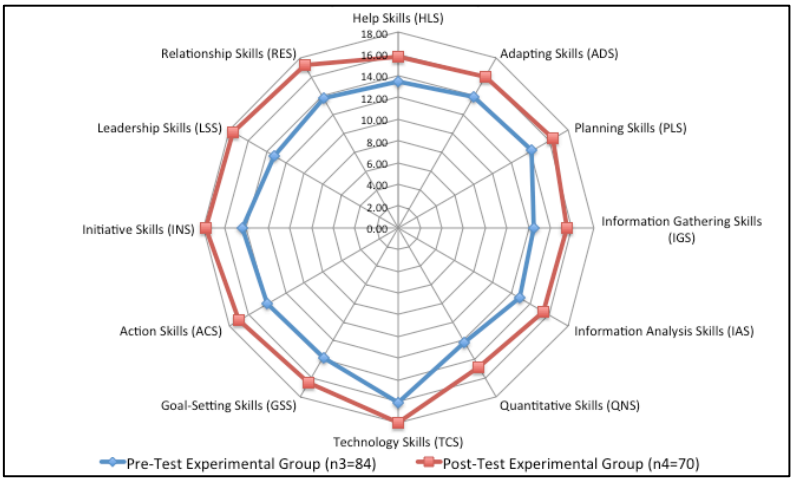

Figure 3. The 12 Management Skills for Pre- and Post-Tests Experimental Group ($n_3 = 84$, $n_4 = 70$)

In addressing the main RQ, we have conducted a t-test on the mean increases of the 12 management skills between the experimental group enhancements (Δ_{EG}) and control group enhancements (Δ_{CG}). The overall results indicate a statistically significant difference ($p < 0.001$) between the two enhancements. Figure 4 provides the star-graph view for the mean *increases* (i.e. Δ_{skill}) in the 12 management skills for the experimental and control groups.

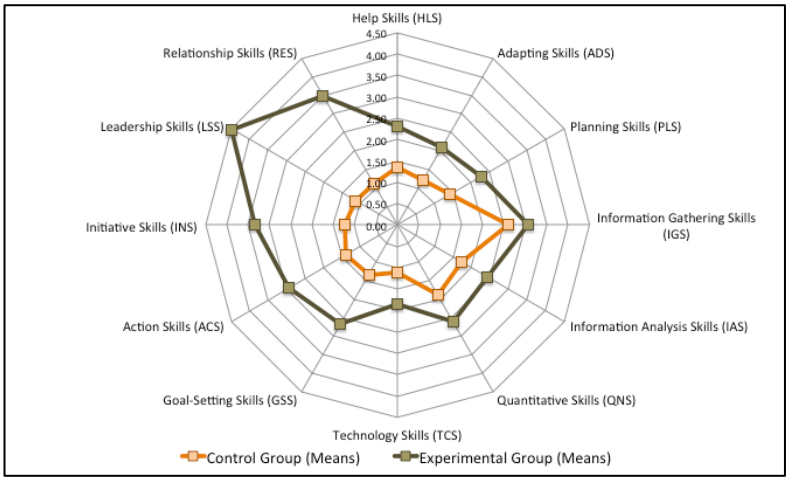

Figure 4. The 12 Management Skills Mean Enhancements for Control vs. Experimental Groups

Table 3 provides an overview of the whole study results including: the means and standard deviations (SD) scores for the pre-test of the control and experimental groups, the post-test of the control and experimental groups, the mean *increases* (i.e. Δ_{skill}) of the two groups, along with the t-test results for the mean increases and significance levels of the 12 skills based on the aggregated scores. While it is evident from the results that all 12 management skills were enhanced via the courses that incorporated computer simulation and competency-based projects, the amount of increase vary slightly among the skills set. For example, we have observed that the greatest degree of increases were (in order of enhancements/significance) on leadership skills (LSS), initiative skills (INS), relationship skills (RES), actions skills (ACS), goal-setting skills (GSS), and help skills (HLS). Marginal degree of increases were observed for adaptive skills (ADS) and planning sills (PLS), while the smallest degree of increases were observed on information analysis Skills (IAS), quantitative skills (QNS), technology skills (TCS), and Information gathering skills (IGS). The one most interesting finding we've encountered is while technology skills, information gathering skills, and information analysis skills were originally anticipated to have significant increases, it might be that the simulation and competency project used did not place emphasis on these skills. This is somewhat paradoxical given that the treatment was the use of online computer simulations. We can only speculate that given the type of students and generation Z participants, the data indicated otherwise. We feel that additional research is needed to uncover these specific issues, including investigation of the specific sub-types of such skills. For example, technology skills may need to be focused more on specific technologies or areas such as Information Technology (IT) skills, Cybersecurity skills, research and analysis skills, and so on.

Table 3. T-test Results for the 12 Management Skills Enhancement Differences for Control vs. Experimental Groups

Management Skills	Pre-Test Control Group (n1=50)		Pre-Test Experimental Group (n2=84)		Post-Test Control Group (n3=49)		Post-Test Experimental Group (n4=70)		Skills Enhancement Control Group (Means)	Skills Enhancement Experimental Group	t	Sig. (2-tailed)	
	Means	SD	Means	SD	Means	SD	Means	SD					
Help Skills (HLS)	13.82	3.28	13.47	3.90	15.16	2.51	15.77	3.70	1.34	2.30	2.99	0.041	*
Adapting Skills (ADS)	14.02	3.64	13.90	3.45	15.25	3.10	16.00	3.37	1.23	2.10	2.65	0.057	
Planning Skills (PLS)	14.30	3.90	14.20	3.43	15.72	2.96	16.46	2.76	1.42	2.26	2.47	0.069	
Information Gathering Skills (IGS)	13.10	3.73	12.47	3.48	15.70	3.33	15.54	3.50	2.60	3.07	1.02	0.366	
Information Analysis Skills (IAS)	13.12	4.07	12.94	3.18	14.86	3.29	15.38	3.43	1.74	2.45	2.06	0.108	
Quantitative Skills (QNS)	12.96	4.44	12.16	3.62	14.84	3.36	14.77	3.42	1.88	2.61	2.10	0.104	
Technology Skills (TCS)	15.50	4.08	16.08	4.41	16.61	3.90	17.92	3.43	1.11	1.84	2.13	0.103	
Goal-Setting Skills (GSS)	14.50	3.73	13.78	3.83	15.84	3.40	16.46	3.50	1.34	2.69	3.69	0.021	*
Action Skills (ACS)	14.56	3.84	13.98	3.76	15.96	2.97	16.92	2.69	1.40	2.94	4.39	0.012	*
Initiative Skills (INS)	15.06	3.91	14.35	3.67	16.28	3.32	17.69	2.56	1.22	3.35	7.71	0.002	**
Leadership Skills (LSS)	15.38	4.40	13.14	4.79	16.51	3.28	17.62	2.93	1.13	4.47	17.39	0.000	***
Relationship Skills (RES)	15.20	3.70	13.82	3.30	16.32	3.01	17.31	2.93	1.12	3.49	5.52	0.005	**
Total Management Skills -->	171.52		164.29		189.05		197.85		17.53	33.56	10.52	0.000	***

* - p< 0.05

** - p< 0.01

*** - p< 0.001

Discussions and Conclusions

In this research, we investigated the role of computer simulations and competency-based projects on a set of 12 management skills during online courses. This study included a 2x2 quasi-experimental design with a control group and an experimental group (not randomly assigned), that comprised of both a pre-test and a post-test assessment of the 12 management skills. Overall, six courses – three undergraduate and three MBA courses were included. A comparison between the two pre-test groups (experimental vs. control) showed no significant differences ($p > 0.1$), which indicates that the base-comparison is adequate, given that we had no say on the allocation of students into the groups. Our experimental comparison indicated that, while both groups experienced significant increases in majority of the skills, the experimental group that included computer simulations and competency-based projects provided an overall significant ($p < 0.001$) enhancement in the 12 management skills. While our quasi-experiment exhibits some limitations, including a sample of only two institutions, a single professor, narrow type of courses (Project Management & MIS), additional experimentations are needed to uncover the benefits of computer simulations and competency-based projects in skill enhancements within academic courses. Moreover, future work can explore further skills beyond those we have measured depends on the specific academic program and profession category under study. Moreover, we feel that there is a potential to introduce new simulations and competency-based projects, to address those specific skills that we have observed to have smaller degree of skill enhancements, something that may also require additional investigation as well. Also, we feel that there is merit to understand the interactions between learners-to-learners and learners-to-instructor in building skills towards the highest competency levels.

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