Abstract

Few examples of demonstrable program learning improvement projects exist. To provide guidance for those seeking to report program learning improvement, we offer a real example of an implemented learning improvement project for a Computer Information Systems major curriculum. The example follows a six-criteria model and the subsequent standards for assessment outlined in the literature. The six-criteria model includes faculty involvement, readiness for improvement, baseline data, investigating existing curriculum and diagnosing issues, learning intervention, and reassessment. The learning improvement report is written by the faculty in the program. The report is then reviewed and assessed by the university's office of assessment, who provides critical feedback using an assessment rubric. The example learning improvement program provides sample critical traits, curriculum maps, and content tables for before and after the implementation of the intervention, and the modifications made to each course in the curriculum to improve learning.

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Example of a Program-Level Learning Improvement Report

To evidence learning improvement a program must assess students, effectively change curriculum and/or pedagogy, and then reassess to affirm the changes resulted in better learning (Fulcher, Good, Coleman, & Smith, 2014). Such learning improvement in higher education is exceedingly rare (Banta & Blaich, 2011; Blaich & Wise, 2011). To provide more specificity with respect to how learning improvement can be achieved and reported, Fulcher, Smith, Sanchez, Ames, and Meixner (2017) created a rubric outlining the criteria of a successful learning improvement project. The 2017 paper also includes a hypothetical report that would receive the rubric's top marks. This paper moves the improvement conversation from hypothetical to actual by providing a real-life example. Before delving into the example, we provide brief historical context.

In 2011 James Madison University's (JMU) assessment office noticed a trend. While the quality of assessment was getting better across the university, examples of programs using results and evidencing improvement was virtually non-existent. This finding—that high-quality assessment was not leading to better learning—was concerning (Fulcher & Bashkov, 2012). At about the same time, JMU's faculty development office was looking to have a bigger impact. Their teaching and learning initiatives were aimed primarily at individual faculty teaching their individual courses. While helping faculty at this level is a worthwhile endeavor, it has less impact than interventions designed to affect many faculty and many courses. Representatives from both offices had an idea: Together they could provide a service aimed at improving student learning at the program level—they only needed to identify the right academic programs to partner with.

In the fall of 2014 the two offices created a request for proposals (RFP). The RFP (available at http://www.jmu.edu/learningimprovement/learning-improvement-by-design/learning-improvement-rfp.shtml) was shared with a select group of academic degree programs that had a record of strong assessment and an interest in improving teaching

and learning. The purpose of the RFP was to identify the programs that were ready for improvement (Fulcher et al., 2014). In other words, the assessment and faculty development offices believed these programs would have a high probability of success.

The Computer Information Systems (CIS) program emerged as one of two programs chosen as pilots. CIS was noteworthy in that it valued teaching and learning, had faculty willing to work together, and had an internal champion (the first author, Lending) who had experience working with both the assessment and faculty development offices. What follows is a description of this program and their successful learning improvement effort.

Description of the CIS Program

The Computer Information Systems and Business Analytics academic unit is part of the College of Business at James Madison University (JMU). In the 2016–2017 academic year, 131 students graduated with a Computer Information Systems (CIS) degree and 48 graduated with a minor in CIS.

The CIS major at JMU prepares business students for careers that focus on the design, development, implementation, and management of information systems. Students use the latest computer-based technology and work on significant problems in organizing, representing, manipulating, and presenting data, information, and knowledge. The major develops CIS professionals who can analyze business problems, then design and build solutions to those problems leveraging information technology. Most of the program's graduates are hired as information technology consultants or systems analysts, where it is necessary to gather and understand business and computer system needs. The CIS faculty use a variety of teaching methods including lectures, case studies, programming projects, and business simulations to prepare graduates with technical, analytical, and problem-solving skills; effective communication and presentation skills; hands-on experience; and the ability to work effectively in individual and team-oriented environments.

The CIS program at JMU is heavily invested in continuous improvement as attested by its double accreditation: as an Information Systems program by ABET (formerly known as the Accreditation Board for Engineering and Technology) and as part of the College of Business accredited by the Association to Advance Collegiate Schools of Business (AACSB.) As such, the CIS faculty were eager to participate in a program that would improve student learning in an important objective of the program.

At the time, the CIS program at JMU had 13 full-time faculty teaching in the program, 11 of whom taught the courses targeted for the improvement initiative. The program consists of nine required courses and two electives (chosen from multiple options). Initially, seven of the required courses were included and eight faculty were directly involved in the learning improvement project.

Example Learning Improvement Report

The next part of this paper consists of an example learning improvement report that describes the learning improvement project undertaken by the CIS program at JMU. The report consists of five sections. In the first section, we discuss Requirements Elicitation, the student learning outcome (SLO) that was chosen for improvement, and why it was chosen. We next discuss baseline data collection, specifically our development of a metric to assess the quality of requirements elicitation, data collection, and measurement. In the third section, we describe our investigation of the curriculum before the learning improvement and diagnose why student performance was unsatisfactory. The fourth section describes our learning intervention, the timeline for intervention, and how the intervention was implemented. Finally, we reassess learning on this SLO and discuss the improvements in student learning.

This example is annotated throughout showing the relationship between our narrative and Fulcher et al.'s rubric (2017). The rubric itself includes six criteria, which are further broken down into 17 standards. Each challenging standard is evaluated on a five-point scale ranging from 0 = absent, 1 = beginning, 2 = developing, 3 = good, and 4 = exemplary. The standards are outlined here:

A. Faculty Involvement

B. Readiness for Improvement

    1. SLO selected
    2. SLO elaborated in detail
    3. Assessment instruments match with SLO

C. Baseline data

    1. Data collection timing and sampling
    2. Psychometrics

D. Investigate existing curriculum and diagnose issues

    1. Program-level curriculum relative to SLO
    2. Individual course-level coverage of SLO content
    3. Insights regarding why efforts are not as effective as intended

E. Learning Intervention

    1. Percentage of students in program affected
    2. Program-level intervention
    3. Course-level intervention
    4. Faculty development for intervention
    5. Intervention timeline
    6. Intervention implementation and fidelity

F. Re-assess

    1. Re-assessment of SLO
    2. Magnitude of student learning improvement

COMMENTED

Provided good evidence of faculty involvement (Standard A.1.) The vast majority of relevant program faculty participated, most of them at every stage of the assessment process. Recall that this annotation and the ones that follow relate to the learning improvement standards rubric introduced by Fulcher et al. (2017).

Faculty Involvement

There was broad agreement among the participating faculty and the departmental leadership that program learning improvement is a collaborative activity supported by heavy faculty involvement "buy-in" to the assessment process. To achieve success in this program-level learning objective, the faculty were committed to program-wide changes including changes to individual courses. Eight faculty from the department were initially involved in the learning improvement project; by the end of the project 12 of the 13 faculty members had been involved.

Readiness for Improvement: Requirements Elicitation

The CIS program endeavors to produce students who can determine the requirements for an information system. This goal is articulated through one of the program's curriculum objectives, Program Objective 1e: "Analyze an Information Systems problem and **identify and define the computing requirements appropriate to its solution**."

A requirement is a statement of what an information system must do. In the typical approach to systems development, information systems analysts interview business clients about what they need from their new system. Typically, both current system users and potential future users of the problem-solving new system are interviewed by the analyst. Once the requirements are elicited and identified they are analyzed, and the information system is afterward designed and built. While eliciting and gathering requirements is arguably the most important phase of developing a system, it is typically done poorly, and the process needs to be improved (Browne & Ramesh, 2002).

Over half of all information system failures are due to problems with requirements elicitation (Dennis, Wixom, & Tegarden, 2015.) Poor communication skills have been identified as a major obstacle in determining requirements (Havelka, 2003). "Success of interviews is highly dependent on the systems analyst's human relations skills" (Whitten & Bentley, 2008, p. 166) The problem we have identified in our program is that while we teach students the basics of requirements elicitation (RE), presentation and discussion alone is not enough for developing competent skills. That is, students need practice doing it to be successful at it.

The idea for this learning improvement first arose when student teams in a CIS class were assigned projects to develop systems for nonprofit organizations. One of the student teams was assigned to develop a system for someone who is also a CIS professor. After the student teams met with him to determine requirements, he commented to other departmental faculty that the students appeared to have no concept of what questions to ask or how to ask them. He asked where concepts regarding the requirements-gathering process were typically taught in the curriculum. The answer was that the concepts were presented abstractly in a course titled "Systems Analysis and Design" but that students never had the opportunity to practice or perform the actual requirements-gathering activity during their course of studies. In fact, in most courses within the curriculum the requirements are already given to students in written form. The students examine the requirements, analyze them, and develop their solutions based upon the written document. In these courses, the students do not have to practice how to elicit requirements.

In the "Systems Analysis and Design" course students develop requirement elicitation questions for interviews, but they do not actually interview someone to determine the requirements, and they get answers regardless of whether they ask the right question or not. In a second class, the program capstone course, students interview a user to develop a system. However, students receive no feedback on their interviewing techniques. Thus, students have no opportunity to learn from their mistakes and improve. While one chance to determine requirements is better than none, the program faculty believe that students should be given more opportunity to learn the interviewing and communication skills involved in learning how to gather and determine requirements.

Further evidence of this problem occurred at a College of Business Executive Advisory Board meeting where stakeholders provide feedback on the performance of recent graduates. A member of the board commented that his recently hired graduates cannot determine the requirements or come to a common understanding of what the user truly wants for a system. Obviously, a program that has an objective that clearly states the importance of identifying and defining requirements should not have such a gap in what has been identified as the most critical phase in the development of information systems.

Baseline Data to Support our Learning Improvement Initiative

Data collection. Data were collected preintervention (Spring 2015) in two sections of "Systems Analysis and Design." At the end of the semester students working in groups were assigned a homework assignment to elicit requirements from a client and to develop a design prototype. Baseline data was collected from 13 groups, each comprising three to five students, which represented approximately 50% of the 2015 graduating class. In practice, RE is best done by teams; therefore, that is why we collected data at this level. Students generally gave good effort for this assessment given that it counted toward a course grade.

COMMENTED

Provided *developing to good* collection of baseline data (Standard C.1). CIS uses a direct measure (a rubric), collects data before the intervention, and has motivated students. CIS does not reach exemplary in this area because the sample is about 50% of the target population and not randomly selected.

Requirements were identified by the students through interviewing a faculty member who role-played a client. The interviews were video recorded for assessing RE techniques. It should also be noted that these particular students were taught RE using our past presentation and discussion-based techniques.

Rubric development. To carry out the baseline assessment the CIS faculty first needed to develop an assessment rubric. Development of the rubric began with a small team consisting of two CIS faculty members (who had conducted RE interviews professionally), the director of JMU's Center for Assessment and Research Studies (CARS), the director of JMU's Center for Faculty Innovation (CFI), and a doctoral student affiliated with both CARS and CFI. This five-person team began the rubric development with two content analysis processes. In our content analysis methodology we took a grounded approach and let concepts emerge from the data.

For the first content analysis members of the research team interviewed two experts at requirements determination, both of whom worked in the for-profit sector. In our second content analysis approach we used actual student performance to drive the construction of the rubric (Ezell, Lending, Kruck, Dillon, & May, 2016). The faculty member who role-played the client in the student interviews led this process. First, she was debriefed by two CIS faculty members about the interviews. Second, she identified two RE interviews that all team members should watch.

After that, the team met to define the criteria based upon the themes that they thought had emerged from these independent content analyses. Once the criteria had been defined, two members of the team produced a draft for competency levels which was then revised and approved by the remainder of the team. The proficiency levels for each trait were 1= beginner, 2 = developing, 3 = competent, 4 = excellent, and 5 = outstanding experienced professional. The goal was that student teams would be rated competent when they graduated.

COMMENTED

***Exemplary* on SLO elaboration and alignment with assessment measure (B.2 & B.3). The CIS program simultaneously unpacked their SLO on requirement elicitation and developed a behaviorally elaborated SLO and its match with the rubric were confirmed by experts internal and external to the program.**

Two other CIS faculty members then joined the team. They watched the same two videos and rated them using the rubric. Minor changes to the rubric were made for usability and then the rubric was "frozen."

As shown in Table 1, the rubric identified eight critical traits that a successful RE interview should have. Descriptions of behavior were written for every trait (8) at every proficiency level (5) for a total of 40 behavioral anchors.

Table 1: Critical Traits of Requirements Elicitation (RE)

A	**Overview:** Provides an organizational frame for the client, agenda, purpose, what hope to accomplish in the interview
B	**Analyze Current State (As Is):** Understand the current situation (e.g., *process, system, data, artifact)*. Asks what is good and what's bad about the current situation, process, system, or artifacts as appropriate
C	**Design the To-Be System**: Design the To-Be system with the client as part of the interview
D	**Visualization** (when applicable)**:** Uses appropriate visuals such as wireframe diagrams, interface structure, process models, current or to-be reports, visual mapping, etc. to aid relevant aspects of meeting. Use visuals to understand scope. Effectively integrates visuals into discussion
E	**Closing:** Recap, plans next step, final questions
F	**Relationship Building:** Appropriate greeting (stands up, shakes hands, introduces self, asks how the other is doing), eye contact, attentive, positive affirmation
G	**Active Listening:** Pays attention, provides feedback, summarizes or paraphrases ideas, remembers past answers, asks for appropriate clarification
H	**Team Work** (when applicable): To the client, the team appears natural and appropriate. Roles and responsibilities (such as questioner and note taker) appear natural. (Roles may shift over interview and not each team member needs to ask a question.) Team members provide different points of view, leader keeps team on track, and inter-team communication aids elicitation.

Baseline measurements. To evaluate student performance a team of nine faculty members were trained on the rubric. To promote interrater reliability two videos were selected to calibrate the ratings across faculty members. After some further training each faculty member was then tasked with independently evaluating student performance using the rubric. The various faculty scores for each group were then averaged. At least two faculty members rated each video.

Table 2 shows the results of the first effort at evaluating the students' RE abilities. The mean overall rating was 1.96, which indicates that the students were rated as developing. This rating did not live up to the original goal of competence (mean overall rating of 3 or higher) and served to further validate that the past techniques of teaching RE were not effective.

Table 2: Baseline Measurements of Preintervention Students

	Trait	Spring 2015 Pre-intervention (N = 13 teams)	
		Mean	SD
	Total	**1.96**	**0.31**
A	Overview: Provide an organizational frame	1.34	0.38
B	Analyze Current State (As Is)	1.63	0.53
C	Design "To Be" System	2.81	0.38
D	Visualization techniques	1.68	0.75
E	Closing: Provides appropriate recap	1.49	0.64
F	Relationship Building	2.31	0.42
G	Active Listening	2.46	0.39
H	Team Work	1.99	0.27

Investigating the Existing Curriculum and Diagnosing Issues

To begin improving the abilities of students to elicit requirements, seven CIS faculty members committed to a week-long workshop that was held in June of 2015. The workshop was facilitated by members of the Center for Faculty Innovation (CFI) who served to mentor the CIS faculty members through the process of determining why students were not learning RE effectively and how they could intervene to improve learning.

During the workshop, the seven faculty members first investigated how and where RE skills were explicitly taught across the curriculum. The seven faculty members present taught most of the courses in the curriculum. Each brought syllabi and course exercises to the workshop. As shown in Table 3, a curriculum map was then created and was used to show the degree to which RE interviews were explicitly covered prior to this workshop.

As shown in Table 3, three courses (shaded) explicitly addressed requirements elicitation interviews. One of these courses, "CIS 454 Systems Analysis and Design," theoretically covered how to conduct an RE interview at a major level (e.g., over a week was dedicated to presentation and discussion). A second course, "CIS 484 Information Systems

COMMENTED

Faculty development for intervention is exemplary (E.4). Many CIS faculty worked with an educational developer for a week to investigate their current curriculum and to create new interventions. Recall that the faculty had also consulted two outside experts regarding good elicitation requirement skills.

COMMENTED

The program did a *good* job investigating the program-level curriculum relative to the SLO (D.1). The program investigated how the SLO was covered across courses and discovered that there was little scaffolding. This area could have been strengthened by including students in the review process.

Table 3: CIS Curriculum Map Highlighting Courses That Explicitly Addressed RE Before the Improvement

Course/Learning Experiences	Requirements Elicitation Interview content
COB 204. Computer Information Systems	1
CIS 221. Principles of Programming	0
CIS 301. Operating Systems and Server Administration	0
CIS 304. Enterprise Architecture	0
CIS/CS 320. Computing and Telecommunications Networks	0
CIS 330. Database Design and Application	0
CIS 331. Intermediate Computer Programming	0
CIS 454. Systems Analysis and Design	3
CIS 484. Information Systems Development and Implementation	3

Development and Implementation", theoretically used RE for a major part of the course (e.g., students were expected to use their skills to conduct an interview with a client). In addition, an early course in the curriculum, COB 204, *theoretically* described the purpose of an RE interview. Via this investigation, common themes emerged amongst the faculty that included: properly eliciting requirements is an essential skill of IS professionals; the program needs to create a more cross-course strategy rather than teaching RE in a silo; and more coverage of RE techniques should be included across more of the courses in the CIS curriculum.

After discussing which courses explicitly presented and discussed RE interview topics, the faculty then debated what critical elements of the RE rubric were actually being taught in some form in each of the courses. Table 4 shows the final results of these discussions. For example, CIS 221 Principles of Programming, although not focused on RE, does teach designing "to-be" programs and uses visualization to a slight degree (items C and D from the Critical Traits presented in Table 1). Via this exercise, the faculty began to realize as a team that RE skills were being taught in some manner in various courses. However, there was no common focus on RE specifically nor any cohesiveness across courses. As a result, the faculty agreed that the problem was this lack of a common focus on RE specifically and agreed that as a team the faculty could address the issue. More specifically, creating a common language and setting common goals relating to RE across courses was determined by the team of faculty to be a worthwhile endeavor. In addition, the faculty agreed that adding more learning objectives that relate to the various critical success factors of an RE interview across the curriculum would add significant value.

COMMENTED

The program did a good to exemplary job drawing conclusions from their investigations (D.3). The faculty identified areas at the program- and individual course levels. They did this with a faculty developer who could be considered an external reviewer. Nevertheless, the insights section could have improved with student involvement.

Further highlights of the initial investigations include:

- Five of the eight critical traits needed to successfully determine requirements through an interview were addressed slightly in a few classes (i.e., Overview, Closing, Relationship Building, Active Listening, Team Work). It was clear from the assessment that simply telling students

to do these steps in an RE interview was not enough to enable them to do it effectively. Students needed to become more aware of why they needed to do these steps and see how these steps added to an interview.

- While the other three critical traits (i.e., Analyze As Is, Design To Be, Visualization) were addressed extensively in multiple classes, and students demonstrated high skills in those areas in other contexts, students did not bring these skills to the RE interview. For example, the two faculty members who taught CIS 454 were particularly puzzled since they had both used an active learning exercise on the topic of visualization the week before the interviews. In the learning exercise, students were taught and used visualization as a method of determining report requirements. Yet, only two of the 13 teams used visualization in their recorded interviews. Clearly students did not transfer the knowledge of a visualization technique to the need to use a visualization technique in an RE interview.
- The faculty team discovered that other courses that at first glance did not seem to include content necessary for RE interviews actually addressed prerequisite content that was needed for a successful requirements elicitation. The faculty decided that it should intervene to make sure that students were provided a framework that pulled together all of the skills and content from multiple courses to perform a successful RE interview. It was determined that the RE interview rubric might help provide that framework.

Learning Interventions

As a result of identifying problems in summer 2015 and agreeing that there was a need for change, eight of the nine courses shown in Table 3 were modified for the 2015–2016 academic year. Twelve of the 13[1] fulltime faculty members who taught these courses were actively involved in the changes. Given that all eight courses are required for all majors, 100% of the students in the program were affected in multiple courses. Note that each of the eight courses were modified to some degree; however, the most extensive modifications were in CIS 454 Systems Analysis and Design (see Table 5 for course coverage after the intervention). What follows is a short description of each course modification (i.e., learning intervention). A summary by course is given in Table 6.

Modification 1: Increasing Awareness of RE and the Interview Process. In most of the courses in the curriculum, we changed several assignments to more clearly frame RE and to specifically use the words from the RE rubric. For example, in COB 204, an introductory CIS class, the Access tutorial workbook was changed so that the language of the workbook coincided with the rubric. Additionally, assignments in the workbook were rephrased so that they were in response to client requirements. Similar changes were made to most courses in the CIS curriculum.

In CIS 304, the language of the class had always used the language of the RE rubric (e.g., as is, to be, visualization); however, the concepts had never been tied to the concept of RE. Requirements elicitation framing was added to every exercise, assignment, and exam question in the class. For example, in an in-class exercise that originally asked students to draw a visualization of an as-is process, the exercise was rewritten to say *"You conduct requirements elicitation interviews to understand [the client's] "as is" Buy and Sell processes. The notes you took in the interviews are shown below. Your next task is to produce a visualization of these processes using Activity Diagrams."*

COMMENTED

The program-level intervention (E.2.) is *good to exemplary* as the program shows a curriculum map, and describes how the classes scaffold students' knowledge and skills. This process was conducted with a faculty developer who could be considered an external reviewer. Nevertheless, this section could have improved with student involvement.

COMMENTED

Note the number (4), strength, and specificity of this program's learning modifications. The CIS program did an excellent job of laying out these interventions.

[1] The 13th faculty member who teaches one of these eight classes retired in May 2017 and chose not to be involved in the project. Another faculty member who taught the same course made changes to a course project which was completed by all students regardless of professor. We plan to involve the retiring faculty member's replacement in the project.

COMMENTED

The program did a *good* job investigating the course-level coverage of SLO content (D.2). Faculty investigated in more detail how particular courses interfaced with facets of the SLO. This area could have been strengthened by including students in the review process.

Table 4: Requirements Elicitation Content Covered in Prevention Courses

Course/Learning Experiences	A Overview	B Analyze "As Is"	C Design "To Be"	D Visualization	E Closing	F Relationship Building	G Active Listening	H Team Wor
COB 204. Computer Information Systems	0	1	1	1	0	0	0	0
CIS 221. Principles of Programming	0	0	1	1	0	0	0	0
CIS 301. Operating Systems and Server Administration	0	0	0	0	0	0	0	0
CIS 304. Enterprise Architecture	0	2	2	3	0	0	0	1
CIS/CS 320. Computing and Telecommunications Networks	0	0	2	1	0	0	0	1
CIS 330. Database Design and Application	0	3	3	2	0	0	1	0
CIS 331. Intermediate Computer Programming	0	0	3	3	0	0	1	1
CIS 454. Systems Analysis and Design	1	2	3	3	1	1	1	1
CIS 484. Information Systems Development and Implementation	1	2	3	2	1	1	1	1

Note. Course coverage of requirements elicitation trait prior to intervention: 0 = no coverage; 1 = slight coverage; 2 = moderate coverage; 3 = major coverage

Table 5: Requirements Elicitation Content Covered in Postintervention Courses

Course/Learning Experiences	A Overview	B Analyze "As-Is"	C Design "To-Be"	D Visualization	E Closing	F Relationship Building	G Active Listening	H Team Work
COB 204. Computer Information Systems	0	1	1	2	0	1	1	1
CIS 221. Principles of Programming	0	1	1	1	0	0	0	0
CIS 301. Operating Systems and Server Administration	0	0	0	0	0	0	0	0
CIS 304. Enterprise Architecture	0	3	2	3	0	1	2	1
CIS/CS 320. Computing and Telecommunications Networks	0	2	2	2	0	2	0	2
CIS 330. Database Design and Application	0	3	3	2	0	1	2	1
CIS 331. Intermediate Computer Programming	0	0	3	3	0	1	1	2
CIS 454. Systems Analysis and Design	3	3	3	3	1	3	3	3
CIS 484. Information Systems Development and Implementation	2	2	3	2	1	2	2	2

Note. Course coverage of requirements elicitation trait after intervention: 0 = no coverage; 1 = slight coverage; 2 = moderate coverage; 3 = major coverage

COMMENTED

The courselevel intervention (E.3) is *exemplary*. As noted earlier 11 of 12 faculty teaching these courses participated in the intervention and changed their course-level SLOs and assignments accordingly.

Table 6: Curriculum Map and Modifications

Course/Learning Experiences	Modifications Tied to Course/Learning Experiences
COB 204 (Computer Information Systems)	• Added an in-class activity about gathering requirements during an interview. Discussed the importance of requirements elicitation during an interview (with a client), and the overall process • Added two exam questions about differentiating "as-is" vs. "to-be" and identifying the "client" in a given situation • Changed the tutorial book for the course so that the entire book is framed with requirements elicitation language
CIS 221 (Principles of Programming)	• Added an assignment that gets students familiar with requirements elicitation vocabulary and as-is vs. to-be
CIS 304 (Enterprise Architecture)	• Added several course objectives relating to visualization and analyzing as-is and to-be states • Added requirements elicitation introduction in first week of course to give a frame for why we use as-is, to-be, and visualization • Revised five in-class exercises, three homework assignments, and three exam questions, to explicitly reflect requirements elicitation (e.g., clients, requirements, as-is, to-be, and visualization)
CIS 320 (Telecommunications)	• Require all students to do the ITERA Case study for the course's group project assignment. The ITERA Case study places a large demand on the student groups in performing requirements analysis and planning. Extensive work on the to-be portion of requirements elicitation is performed on the Case Study project.
CIS 330 (Database Design and Application)	• Added several dedicated discussions and learning activities in the middle of semester. Addressed the necessity and values of properly eliciting client's requirements • Added a 30-minute interactive lecture including video discussions • In our term project, students practiced requirement elicitation with a role play exercise.
CIS 331 (intermediate Computer Programming)	• Added three course objectives focused on the importance of visualization for all aspects of communication with the client, on the use of visualization to describe and plan the to-be system, and to reinforce understanding the attributes of successful teams • Added an in-class visualization group exercise to demonstrate how a visualization can reduce uncertainty and increase clarity of client needs and system implementation plans
	• Made small changes to lectures throughout semester to reinforce importance of thorough elicitation of client-system requirements in individual and group homework projects, and to reinforce importance of team dynamic in successfully accomplishing this
CIS 454 (Systems Analysis and Design)	• Added several new course objectives related to requirements elicitation • Introduced the requirements elicitation rubric in the discussion of a requirements elicitation interview • Added an in-class activity to view requirements elicitation elements and discuss the quality of each • Added a course assignment that required the students to view two 20-30 minute requirements elicitation interviews and evaluate the success of each interview with the requirements elicitation rubric • Added a team assignment of a requirements elicitation interview that required each team to elicit requirements for a report from the semester case. Student teams participated in a debrief were their elicitation was reviewed and evaluated. Positive and corrective feedback was provided during the debrief using the rubric as an evaluation tool • Added three questions to test 1 and seven questions to the final exam on requirement elicitation
CIS 484 (Capstone—Information Systems Development and Implementation)	• Added requirements elicitation for a real client for as-is and to-be systems

Modification 2: Using the Requirements Elicitation Rubric. The rubric was introduced to students in several courses. In CIS 304 and CIS 330, relevant portions of the RE rubric were shared with students. In CIS 454, the entire rubric was presented and discussed with students. In addition, as a homework assignment in CIS 454, students watched video recordings of prior students conducting RE interviews. Students then rated these interviews using the rubric. And faculty members in CIS 454 and CIS 484, evaluated actual student RE interviews using the rubric.

Modification 3: Practice Skills in Requirements Elicitation Interview. In all courses where it made sense, faculty added an exercise where students actually conducted RE interviews. An entire-class RE interview was added to CIS 304. In CIS 330 and CIS 454, students needed to interview the faculty member role-playing a client to determine requirements for a database and a report respectively. In CIS 484, students conducted an RE interview with a real client to determine requirements for a system.

Modification 4: Using videos about requirements elicitation as a teaching tool. We obtained permission from several student groups to use their videos to help teach other students. For example, students watched videos in CIS 330 and CIS 454 of a good RE and a bad RE and instructors led them in discussions of what worked and what did not work along with suggestions for improvement. One faculty member composed snippets of recorded student interviews that contrasted good and bad techniques and developed teaching tools that could be used in multiple courses.

Timeline for Learning Improvement Project. An overview of the timeline is provided in Table 7. Academic year 2014–2015 was devoted to establishing a baseline, understanding RE, designing a rubric, and developing course interventions in an intensive 5-day workshop. Later that summer, the seven faculty who attended the workshop shared the modifications with those faculty members who could not attend the workshop.

COMMENTED

In combination with Table 5, Table 7 presents an *exemplary* timeline (E.5). Pre- and post-assessments are laid out before and after the interventions. Time is allocated for instrument development and program/course modification relative to the SLO.Again, note that there are dramatic interventions embedded within the timeline.

Table 7: Timeline for Learning Improvement in the CIS Program

When	What was done
Fall 2014 - Spring 2015	• No courses were changed. • Students would have taken the full curriculum without intervention. • Collect baseline assessment data • Develop assessment rubric
Summer 2015	• Attend weeklong workshop to design course interventions
Fall 2015	• Include course interventions in 7 of the required courses in curriculum • Meet to discuss interventions
Spring 2016	• Include modified course interventions in 8 of the required courses in curriculum • Fidelity assessed in 4 courses • Collect assessment data • Students would have taken two semesters of courses with interventions and the rest of the major without. The most likely courses that they would have taken with changes were CIS 330, CIS 331, and CIS 454.
Summer 2016	• Attend weeklong workshop to refine course interventions • Discuss fidelity observations
Fall 2016 – Spring 2017 (planned)	• Changes were made to all required courses in the curriculum with new refinements in academic year 2016-2017. • Collect assessment data. • Students would have taken four semesters of courses with interventions. It is likely that most students would have taken changed courses for the entire curriculum except possibly COB 204 and CIS 221.

COMMENTED

Regarding, intervention implementation fidelity (E.6), the CIS program's efforts were *developing to good*. As a group they monitored the progress of the implementation. And, in a few cases, looked at courselevel implementation fidelity through auditing. Had this been done on a larger, more systematic level; and, had students been involved, this standard would have been rated *exemplary*.

In fall 2015 semester, the course interventions were implemented in seven courses. Following the semester during December 2015, the entire faculty group met to share how the course modifications had worked that semester and to discuss how to improve them. Most of the faculty were able to increase awareness of the RE interview process (Modification 1) in the required courses, but not all. Four of the faculty were able to include practice skills in RE (Modification 3) for the key courses identified by the group, and three faculty used videos as a teaching tool for RE (Modification 4). Much of the faculty discussion involved how to include new classroom exercises into an already busy semester. Those that were unsuccessful sought solutions to implement in the following spring, using the January holiday for planning.

Representatives from CARS and CFI both attended the meeting. The CFI representative discussed implementation fidelity and asked whether faculty members would consider having CFI representatives sit in on classes in the spring to assess fidelity. Several faculty members agreed and fidelity assessments were conducted in spring 2016.

At the end of spring 2016, student performance in RE was recaptured and reassessed. At this point students would have taken two semesters of changed courses. Students do not progress as a cohort, so each student would have followed their own path through the courses—but most would have taken a majority of their courses in the changed curriculum. We consider this a "partial modification" time point.

COMMENTED

Provided *good* re-assessment of the SLO (Standard F.1). CIS used the same methodology as before, including the same rubric and data collection processes. Had the sample sizes been larger (i.e., above 50-60% of student) or the case made better about the representativeness of the sample, then this standard would have been *exemplary*.

In the summer of 2016, faculty spent four days in an additional workshop to further refine the exercises for these courses and to consider the fidelity of the interventions. By the time students were given the assignments in spring 2017, all students would have taken most their curriculum post-intervention. This is considered a "full modification" (see Table 7 for details on the timeline for the intervention).

Re-Assess: Impact of Intervention

As mentioned earlier, during the spring 2015 semester we established baseline results by assigning a homework assignment in CIS 454 to elicit requirements and develop a design report. The students elicited requirements by interviewing a faculty member who role-played a client. The interviews were video recorded and were evaluated using the eight critical success factors of the rubric. The second set of data were collected from 15 groups, again each comprising three to five students, which represented approximately 60% of the 2016 graduating class. However, students who completed the course in spring 2016 were exposed to two semesters of course modifications designed to enhance SE skills. In other words, these data represented students *after* a two-semester intervention. Figure 1 and Table 8 illustrate the impacts of these modifications.

COMMENTED

Regarding magnitude of learning improvement (F.2), this example is clearly exemplary. The difference between pre and post-assessment is statistically significant and the effect (d =3) is dramatically larger than what is typically considered large (d = 0.8). Further, the difference is practically meaningful. CIS moved students from "developing" on the rubric all the way to "good."

As shown in Figure 1, a significant improvement occurred. More specifically, as shown in Table 8, 2016 students obtained an overall average of 3.10 (Competent) as compared to an overall average of 1.96 (Developing) for preintervention students. Thus, as a department, the CIS faculty were extremely satisfied with this first year result as the goal of competence was finally achieved. Additionally, this notable improvement served as a testament to department-wide hard work and inspired the CIS faculty to continue the improvement cycle.

Most of the tasks showed at least a 1-point improvement (on a 5-point scale) from 2015 to 2016. The smallest differences were on Trait C (Design "To-Be" System) and Trait G (Active Listening) which were relative strengths in 2015. The largest differences were on Trait A (Overview) and Trait D (Visualization) techniques. For the total score, the 1.13-point difference on the rubric metric translated to a gain of 3 standard deviations, an unusually large standardized effect. The 95% confidence interval around the total score difference ranged from to 0.8684 to 1.4009, indicating the positive difference between post- and pre-scores was statistically significantly different from zero ($t_{26} = 8.76$, $p < .0001$).

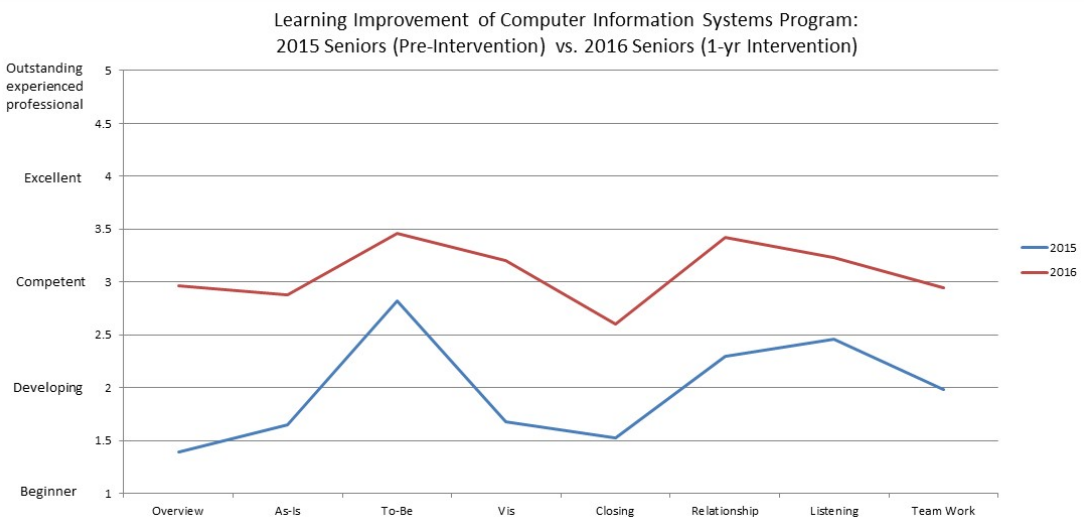

Figure 1. Impact of Course Modifications

Table 8. Impact of Course Modifications

	Trait	Spring 2015 Preintervention (N = 13)		Spring 2016 After one year of intervention (N = 15)		
		Mean	SD	Mean	SD	**Difference**
	Total	**1.96**	**0.31**	**3.10**	**0.36**	**1.13**
A	Overview: Provide an organizational frame	1.34	0.38	2.99	0.56	**1.65**
B	Analyze Current State (As Is)	1.63	0.53	2.89	0.43	**1.26**
C	Design "To Be" System	2.81	0.38	3.49	0.59	**0.69**
D	Visualization techniques	1.68	0.75	3.19	0.40	**1.51**
E	Closing: Provides appropriate recap	1.49	0.64	2.58	0.58	**1.09**
F	Relationship Building	2.31	0.42	3.43	0.43	**1.12**
G	Active Listening	2.46	0.39	3.26	0.49	**0.79**
H	Team Work	1.99	0.27	2.97	0.56	**0.98**

COMMENTED

Psychometrics (C.2) are *exemplary*. The reliability estimates – based on generalizability theory – are reasonably high. Plus, the program provided additional, supportive validity evidence.

Several additional steps were taken to ensure that the results documented in this report can be trusted and that learning improvement gains can be linked to the program-level curricular modification:

- Careful development of the RE interview rubric using inputs from experts as well as those who participated in RE interviews (content validity);
- Maintaining the same rubric throughout the entire learning improvement project;
- Training session was provided to the instructors prior to use of the rubric;
- The Phi Coefficient, an indicator of reliability obtained through generalizability analysis, was .856 when using both years of data (structural validity evidence);
- Students who had more RE intervention were scored much higher on the rubric than students who had less training (known groups/ external validity evidence); and
- More details regarding the technical analysis are available upon request.

Conclusion

In short, the CIS program assessed their outgoing seniors in 2015, planned and enacted a series of interventions aimed at improving RE skills, and then reassessed the following cohort (2016) to find much higher proficiency. That simple but compelling story masks the complexities that make learning improvement so challenging. In accordance with the learning improvement rubric introduced in Fulcher et al. (2017) the CIS example had the following exceptional characteristics:

- high percentage of faculty involvement throughout the project;
- tight focus on a particular student learning outcome;
- very specific elaboration of student learning outcome;
- deep alignment between the assessment instrument and the student learning outcome;
- collection of baseline data on a large sample of program students;
- thoroughly reviewed old curriculum to understand why students weren't meeting learning expectations;
- coordinated curricular and pedagogical changes within and across courses;
- changes affected ALL students in program;
- faculty consulted with faculty development expert to strengthen interventions and delivery;
- faculty consulted with assessment expert to strengthen the assessment process;
- the program established a reasonable timeline to plan, intervene, and reassess, and made modifications along the way;
- the program used the same instrument to re-assess; assessment scores were supported by validity evidence; and
- finally, the actual learning improvement was enormous (Cohen's d > 3).

The bulleted points reflect the longer story: CIS faculty were coordinated, persistent, and strategic in creating this learning improvement, albeit not perfect at every step. In addition, JMU provided the right environment and resources (e.g., assessment and faculty development expertise) to support the process.

Though the CIS program and faculty have reasons to be proud, the point of this article is not to be self-congratulatory. Instead, it is to provide a process and a structure for creating and reporting learning improvement for program-level learning objectives.

Having collectively visited hundreds of institutions across the nation, it is our opinion that every college has at least one program that is ready to make a program-level learning improvement. The question is whether those colleges and universities can provide the environment to support them. Sometimes a good example is a reasonable starting point, and we hope the JMU CIS learning improvement project serves that purpose.

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References

Banta, T. W., & Blaich, C. F. (2011, January). Closing the assessment loop. *Change: The Magazine of Higher Learning*, 22–27.

Blaich, C. F., & Wise, K. S. (2011, January). *From gathering to using assessment results: Lessons from the Wabash National Study* (Occasional Paper No. 8). Urbana, IL: University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment (NILOA).

Browne, G.J., & Ramesh, V. (2002). Improving information requirements determination: a cognitive perspective. *Information & Management, 39*(8), 625–645.

Dennis, A., Wixom, B.H., & Tegarden, D. (2015). *System Analysis & Design: An Object-Oriented Approach with UML, Fifth Edition*. Hoboken: Wiley

Ezell, J.D., Lending, D., Kruck, S.E., Dillon, T.W., May, J.L. (2016) A plan to improve learning of requirements elicitation in an IS curriculum, In A. Morgan & J. Quesenberry (Eds.) *Proceedings of the 2016 ACM SIGMIS Conference on Computers and People Research, June 2–4, 2016*, Alexandria, VA,

Fulcher, K. H., & Bashkov, B. M. (2012, November–December). Do we practice what we preach? The accountability of an assessment office. *Assessment Update, 24*(6), 5–7, 14.

Fulcher, K. H., Good, M. R., Coleman, C. M., & Smith, K. L. (2014, December). *A Simple Model for learning improvement: Weigh pig, feed pig, weigh pig*. (Occasional Paper No. 23). Urbana, IL: University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment (NILOA).

Fulcher, K.H., Smith, K.L., Sanchez, E.R.H., Ames, A.J., and Meixner, C. (2017) Return Of The Pig: Standards For Learning Improvement, *Research & Practice in Assessment, 11*. Retrieved from: http://www.rpajournal.com/return-of-the-pig-standards-for-learning-improvement/, 5/26/2017.

Fulcher, K. H., Sundre, D. L., Russell, J. A., Good, M. R., Smith, K. L. (2015). Assessment progress report template (APT): Revised rubric draft. Retrieved from: https://www.jmu.edu/assessment/_files/APT_Rubric_sp2015.pdf.

Havelka, D. (2003). A user-oriented model of factors that affect information requirements determination process quality. *Information Resources Management Journal, 16*(4), 15–32.

Whitten, J.L., & Bentley, L.D. (2006). *Introduction to Systems Analysis & Design*. New York: McGraw-Hill.