A Rubric to Evaluate and Enhance Requirements Elicitation Interviewing Skills

Diane Lending, Jeremy D. Ezell, Thomas W. Dillon, and Jeffrey May

A Rubric to Evaluate and Enhance Requirements Elicitation Interviewing Skills

Diane Lending
Jeremy D. Ezell
Thomas W. Dillon
Jeffrey May
Department of Computer Information Systems and Business Analytics
James Madison University
Harrisonburg, VA 22807, USA
lendindc@jmu.edu, ezelljd@jmu.edu, dillontw@jmu.edu, mayjl@jmu.edu

ABSTRACT

Eliciting effective requirements is vital for successful Information Systems development and implementation. Interviews with stakeholders and users are an important part of the requirements elicitation process. Thus, teaching students how to better perform requirements elicitation interviews is a critical task for information systems faculty. However, prior to this research, a common tool or rubric to evaluate the effectiveness of requirements elicitation interviews was not found in the literature. The purpose of this research was to develop a rubric that can be used to both evaluate (provide summative measures) and enhance (via formative training techniques) the requirements elicitation interviewing skills of information systems students. The results of this research provide both quantitative and qualitative evidence that the rubric developed and described in this paper substantially improved the ability of our students to conduct requirements elicitation interviews. Along with detailing the various methodologies we used, this paper provides practical pedagogical suggestions and lessons learned along with covering possible future avenues of research in this area.

Keywords: Requirements elicitation, Systems development, IS curriculum, Rubrics, Learning improvement

1. INTRODUCTION

A requirement is a statement of what an information system (IS) must do. In the typical approach to systems development, IS analysts interview business users in an attempt to understand exactly what functionality is desired. (Ali & Lai, 2017; Bano et al., 2019; Bormane et al., 2016; Donati et al., 2017). Once the requirements are identified and analyzed, the information system is built. While gathering effective requirements is arguably the most important phase of developing a system, it is typically done poorly and requires much improvement (Bano et al., 2019; Browne & Ramesh, 2002; Donati et al., 2017). The literature has found that poorly conducted requirements elicitation (RE) accounts for up to half of all system failures (Ali & Lai, 2017; Basir & Salam, 2015; Bormane et al., 2016; Dennis et al., 2012; Wong et al., 2017). Poor communication skills have been identified as a major obstacle in determining requirements (Bano et al., 2019; Donati et al., 2017; Havelka, 2003) with successful interviews a major factor (Whitten & Bentley, 2008). The problem is that while we teach students how to elicit requirements, they do not get enough practice to be good at it. And, as we become more agile, where continual customer feedback becomes the norm, proper requirements elicitation skills grow in importance (Saeeda et al., 2020).

The idea for this research first arose when students in a senior-level Computer Information Systems (CIS) class were assigned a project to develop a system for a non-profit organization. One of the groups was assigned to develop a system for someone who is also a CIS professor. After the group met with this professor to determine requirements, the professor commented that the students had no concept of what questions to ask or how to ask them. The professor asked where we taught them this concept and the answer was that we really did not.

Most courses in our curriculum gave requirements to students in written form. The students extract the requirements, analyze them, and develop their solutions based upon the written document. In those courses, the students do not have to work on how to elicit requirements. In their Systems Analysis and Design course, students twice developed requirements elicitation questions for interviews, but they did not actually interview someone to determine the requirements and they received the answers regardless of whether they asked the right questions or not. In our capstone course, students interview a user to develop a system, but no feedback is given on their interviewing techniques, thus students have no opportunity to improve. While one chance to try to determine requirements is better than none, the faculty believed we should be giving students more opportunity to learn the communication skills involved in learning how to determine requirements. Clearly a

program that has a major objective of having students learn to develop information systems should not have such a gap in what has been identified as the most critical phase in that development.

This paper describes our research project to improve student learning of how to conduct an effective RE interview. We describe the steps that we went through to demonstrate improved student learning in conducting a requirements elicitation interview. To measure student learning, we had to develop a rubric to measure the quality of a requirements elicitation interview. Once we measured the baseline performance of our students without changes in the curriculum, we then made changes to courses across the entire curriculum implementing key RE knowledge and skills via refined and added learning objectives and activities.

The rubric we developed for this project was used both as a summative and formative assessment tool. A summative assessment is a measurement of performance at the end of the process: How well did students perform on their requirements elicitation interview? A formative assessment is the use of the rubric during the learning process, e.g., as a teaching tool to improve student learning. This can include intermediate assessments, students' assessment of their own or others' performance, or any type of learning tool. The rubric developed at the beginning of the project is shown in Appendix A.

We follow this introduction with a literature review that examines the research on requirements elicitation and requirements elicitation interviews, designing and measuring learning improvements, and research on rubrics and their use. We then discuss the methodology of our project including development of the rubric, our change in teaching methods, and the outcomes of those changes. We conclude with a discussion on lessons learned, how we changed the rubric after two years of use, and future research plans.

2. LITERATURE REVIEW

2.1 Requirements Elicitation
A requirement is a statement of what a new information system must do. Requirements elicitation (RE) is the process used to gather the requirements to build an information system (Ali & Lai, 2017; Bano et al., 2019; Davey & Parker, 2015; De Ascaniis et al., 2017; Dieste & Juristo, 2011; Ferrari et al., 2017). This process is not one of collecting requirements that are readily available. Rather, elicitation is a complex and iterative process (Regev et al., 2015) which involves elements of "discovery, emergence and development" (Zowghi & Coulin, 2005, p. 19). The most common technique for eliciting requirements is an interview where a systems analyst, team of analysts, or product owner interview the stakeholders about what they need from their new system (Ali & Lai, 2017; Bano et al., 2019; Bormane et al., 2016; Donati et al., 2017; Gaikwad & Joeg, 2017; Unger-Windeler et al., 2021; Zowghi & Coulin, 2005). Other techniques that can be used in addition to interviews include document analysis, observation, questionnaire, prototyping, JAD Sessions (Dennis et al., 2012) and protocol analysis (Appan & Browne, 2012; Pacheco et al., 2018).

2.2 Learning Improvement
Assessment in higher education too often focuses on the mechanics of assessment instead of the use of assessment for

the improvement of student learning. Simply assessing student learning does not by itself improve student learning. In other words, measuring a phenomenon does not change the phenomenon (Fulcher et al., 2014). Proper assessment includes "using the results" or "closing the loop" to demonstrate learning improvement and the research suggests that there are standards to follow for academic program success (Hersch & Keeling, 2013; Fulcher et al., 2014; Fulcher et al., 2017). A true learning improvement process must contain the following steps:

- Collection of baseline student learning data prior to intervention
- Modifications to the learning environment
- Reassessment of the student learning after the intervention (Fulcher et al., 2014).

Only by measuring student learning before and after the intervention and seeing a change for the better, can you truly feel confident that you have improved student learning. In their later work, Fulcher et al. (2017) further define that a successful program learning improvement should include faculty involvement, changes across the curriculum, learning development activities for faculty, and statistical measures of the improvement.

2.3 Review of Popular Requirements Elicitation Techniques and Learning Approaches
Though an important phase of the information systems development process, requirements elicitation is often poorly executed in practice and contributes to systems that are misaligned with organizational needs (Davis et al., 2006; Turner, 1990; Watson & Frolick, 1993; Zowghi & Coulin, 2005). Improving student requirements elicitation skills through classroom learning tools and activities to better help these future-practitioners to elicit requirements has long been a focus in the literature (Costain & McKenna, 2011; Kaloyanova, 2014; Ramiller & Wagner, 2011; Zowghi & Coulin, 2005; Zowghi & Paryani, 2003). Dozens of techniques have been developed to help bridge the practitioner and requirements quality gap during systems development (Hickey et al., 2003; Pacheco et al., 2018; Zhang, 2007; Zowghi & Coulin, 2005). The literature details many useful techniques adapted for classroom use such as: prototyping; storytelling and user stories; introspection, role-play, and gamification; self-assessment and peer review; and interviewing. Underlying all these experiential learning approaches is the desire to improve the ability of information systems students (who will become future IS professionals) to better communicate in collaborative systems analysis and design activities (Qurban & Austria, 2009).

Prototyping is often used in classroom activities (experiential learning) to give students the opportunity to practice requirements elicitation in a hands-on manner with an existing artifact. Requirements elicitation sessions using a prototype that student teams can demonstrate and discuss, give the teams direction, focus, and shared understandings (Qurban & Austria, 2009), often spurring brainstorming regarding the identification, clarification, and prioritization of user requirements (Hickey & Dean, 1998). Vijayan and Raju (2011) detail the use and effectiveness of paper-based, disposable system prototypes to bolster student RE learning. Either hands-on or paper-based visualizations of systems and system functionalities have been highlighted in the literature as aiding

in effective elicitation of requirements (Browne & Ramesh, 2002; Zowghi & Coulin, 2005).

Storytelling and user stories present to the student the facts, roles, goals, and values of the user and the desired system in the form of a narrative from which requirements must be elicited (Fancott et al., 2012). Pacheco and Garcia (2012) describe research that show storytelling to be an effective communication tool in an RE setting, allowing for more complete generation of system requirements, and a tool that kicks off an almost brainstorming-like activation of knowledge in other users and RE team members. The user story can be relevant to many different stakeholders and helps team members prioritize requirements along with estimating project size (Fancott et al., 2012).

Classroom RE learning activities such as gamification, role-play, and introspection are often used in conjunction with each other. Costain and Mckenna (2011) detail several benefits of role-play in the classroom as stated in the literature, noting its usefulness in activities requiring interaction in a collaborative, interpersonal setting, and its ability to help students retain new learning longer than with traditional lecture methods. Additionally, they introduced role-play in a classroom joint application development (JAD) activity and found increased student perceptions of their ability to elicit client requirements, findings supported by broad reviews of RE technique effectiveness (Pacheco & Garcia, 2012; Pacheco et al., 2018). In most role-play exercises, introspection is used to have students imagine themselves as the user to elicit or clarify requirements. A student's lack of domain expertise can limit this technique's effectiveness in individual exercises (Goguen & Linde, 1993).

Gamification of a learning task involves some elements of role-play and introspection as well. Common in business programs, gamification as an active learning approach can increase the appeal of involvement in students with activities that might normally be seen as mandatory or unappealing (Fernandes et al., 2012). Ramiller and Wagner (2011) found opportunity through gamification of an RE exercise to introduce to students real-world challenges such as uncertainty about client requirements and limitations of recall into the activities. Though varying whether a student team is allowed to interview a client directly or not, Vilela and Lopes (2020) were able to introduce loss of translation to elicited client requirements, similarly introducing real-world complexity.

The interview continues to be the most favored requirements elicitation technique both in and out of the classroom (Alvarez, 2002; Davis et al., 2006). The interview process allows for direct practice of the communication skills of students (Qurban & Austria, 2009), can often generate more information from clients and of a greater variety than methods such as questionnaires (Goguen & Linde, 1993; Pacheco & Garcia, 2012; Pacheco et al., 2018), and have been found to be the most effective technique at generating an exhaustive list of requirements (Alvarez, 2002). Indeed, interviews occur during the majority of RE techniques, particularly those discussed in this literature review. Though one of the easier RE methods, analysts are still found to be poorly capable of conducting effective interviews, with the literature suggesting many ways to reduce biases (Browne & Ramesh, 2002), increase the quality of elicited information through questioning approaches (Vijayan & Raju, 2011; Zowghi & Coulin, 2005), and through observation of the interactive quality of the interview team itself

(Hickey & Davis, 2003). Zowghi and Coulin (2005) have noted the need to reduce the gap between requirements elicitation experts and novices, to improve the quality of RE techniques, and highlight the mission of educators in addressing these issues in the classroom. Due to the often subjective nature of the RE process, our research focuses on the use of a rubric to assess student performance in RE-related learning activities in the classroom.

2.4 Using Rubrics

Our method of measuring student RE interview performance uses a rubric. Reddy and Andrade (2010) define a rubric as "a document that articulates the expectations for an assignment by listing the criteria or what counts and describing levels of quality from excellent to poor." In his classic rubric paper, Popham (1997) says rubrics must contain the following three elements:

- Evaluative criteria which distinguish the skills involved in the task.
- Qualitative definitions that distinguish the level of performance on the criteria. A rubric must have a description for each level of quality.
- A scoring strategy which is either holistic (giving one overall quality judgement) or analytic (scores each criterion separately).

Popham recommends that each criterion in a rubric be teachable. He also recommends that the rubric be shared with the students.

A rubric is recommended as an assessment tool that can be used in the qualitative evaluation of complex work (Jonsson & Svingby, 2007). A rubric has rows that denote the skills being assessed and columns that indicate the level of performance in these skills (Stevens & Levi, 2005). Rubrics make assessment criteria transparent to the student and help the student understand what good performance on a complex task involves (Jonsson & Svingby, 2007).

Bolton (2006) surveyed business students and found that 98% liked rubrics. The reasons for student approval included that the rubric served as a guide to learning, reduced uncertainty, and served as a way to provide feedback. The most common student criticism of rubrics was the potential to reduce creativity. Faculty reported that the use of rubrics allowed them to identify which topics students should focus on and helped to reduce conflicts when issuing and receiving grades.

As well as an assessment tool, rubrics can be used as a learning and teaching (formative) tool. In a review of empirical research on the use of rubrics in higher education, Reddy and Andrade (2010) describe several studies that show that using a rubric as a formative tool as well as a summative tool, promotes learning and achievement by students. Business students reported that being given a rubric allowed them to identify critical issues in an assignment and to focus their efforts (Bolton, 2006). Students reported that the rubric gave them a way to plan their approach and check their work (Andrade & Du, 2005). Andrade (2000) notes that a rubric used as an instructional technique improves communication between teachers and learners. The rubric makes expectations clear and supports the development of learning and skills (Andrade, 2000). Simply handing out a rubric to students, however, was not enough to impact the quality of student work (Reddy & Andrade, 2010). Students must be taught to use the rubric to

achieve the benefits. Furthermore, rubric use is not a replacement for good instruction (Andrade, 2005).

A later review of empirical work on the use of rubrics as a formative tool was conducted by Panadero and Jonsson (2013) where they developed a model on how a rubric helps students learn. Their model suggests that a rubric provides transparency in expectations, which in turn reduces student anxiety, improves students' self-efficacy, aids in the feedback process, and improves students' intrinsic self-regulation of learning.

Greenberg (2015) conducted experiments on whether using a rubric as an instructional technique improved student work in scientific writing. In one experiment, she simply provided the rubric to students as a guide for their own work. In another, the students used the rubric to evaluate another student's writing. In both of her experiments, the students who used the rubrics improved their own writing as measured by her rubric.

Reddy and Andrade (2010) note that faculty tend to perceive rubrics as an easier method to grade objectively. A good rubric provides a strategy to provide individualized feedback to students in a shorter time frame (Andrade, 2005). Faculty are less likely, however, to report that rubrics improve learning. Reddy and Andrade recommend that faculty might be more receptive to developing and using rubrics if they understood this other potential use. A good use of rubrics helps the student understand "what is a quality performance" and gives them a goal to work towards (Arter & McTighe, 2000). If the criteria are sound and truly reflect what quality work is, the rubric can be a guide to learning. It also provides a means for students to internalize the criteria and improve along the various measures.

Lipnevich et al. (2014) conducted an experiment to determine if students' writing improved between drafts when a rubric was used to provide feedback. Their study found notable improvements in the writing skills of students and that rubrics were more effective than various other feedback techniques. Additionally, Lipnevich et al. (2014) comment that successful rubric development and use can make the students aware of their current level of performance, their desired level of performance, and the gap between the two. The students become mindful of this gap and can internalize the steps to improve their performance.

The literature identifies two criticisms of rubrics. The first criticism is the tendency for instructors to over generalize the use of a particular rubric. Both Greenberg (2015) and Lipnevich et al. (2014) identify this as a potential limitation of their work. The second criticism of rubrics is that observation and judgment is subjective. Arter and McTighe (2000) answer this criticism by pointing out that all judgment is subjective, but the rubric makes that subjective process as clear and consistent as possible. The feedback tends to be more specific and helps students understand the important aspects of a quality performance.

In this paper, we describe the process to develop a rubric that could be used by students to learn how to conduct a requirements elicitation interview and by faculty members to evaluate student performance during requirements elicitation interviews. A rubric can be used to evaluate the quality of student interview performance and give actionable feedback. Since the interview seems to be at the core of, or used in conjunction with, many RE techniques, an assessment rubric for student interviews can help improve the quality of many associated RE activities.

3. METHODOLOGY AND RESULTS

The program learning objective that we chose for this project was: "By the time students graduate, they should demonstrate the ability to analyze a problem and identify and define the computing requirements appropriate to its solution." We chose this objective because it is a priority for our faculty. We pride ourselves on the high-quality interpersonal skills demonstrated by our CIS majors on the job. Thus, requirements elicitation should be something that students can perform effectively and we as faculty should be able to judge their performance and provide meaningful feedback for the purpose of improvement. We had no direct measurement, however, of how good students were at requirements elicitation. Thus, our first task was to develop a rubric to measure the quality of students' skills at requirements elicitation.

As discussed in Section 2, the most common technique for eliciting requirements is an interview. We considered measuring student performance in both interviews and other techniques such as document analysis, observation, questionnaire, prototyping, and JAD Sessions. We also considered measuring outcomes such as the quality of the system developed. Fulcher et al. (2017), however, suggests that a learning improvement project is difficult enough that a single highly focused objective is likely to be more successful. Ultimately we decided on a focused objective that considered just the requirements elicitation interview.

3.1 Methodology Overview

The setting for this project was a public university in the Mid-Atlantic region of the United States. The students were all undergraduate students pursuing aComputer Information Systems (CIS) major or minor in the college of business. All of the students were enrolled in a Systems Analysis and Design class traditionally taken in their senior year. There were four sections of the Systems Analysis and Design class with approximately 30 students in each. The course was taught with an object-oriented focus and required the Dennis et al. (2015) textbook as a reference.

Our design was quasi-experimental. We began with a control group that was a cohort of students near the end of their course work in CIS. As part of their team project in the Systems Analysis and Design class, students were assigned to analysis teams of four or five members. Analysis teams were assigned multiple project tasks throughout the semester, such as project planning, project feasibility determination, and use case modeling. At mid-semester, each team was given a related task of determining the requirements for a report by interviewing a client. A faculty member who taught the class role-played the client. The requirements elicitation interviews were recorded and evaluated using the rubric. Similar experimental investigations have been carried out in the requirements elicitation literature and framed a basis for the investigations in this study (Ali & Lai, 2017; Bano et al., 2019; Donati et al., 2017; and Regev et al., 2015). The experimental group is described in Section 3.2. The overall structure and timing of the project and phases is shown in Table 1.

Time	Task	Discussed in Section
Year-0	Planning	3.2
	Develop and Freeze Rubric	
	Conduct Baseline Measurement (Pre-Intervention)	
	Plan Curriculum Improvements	
Year-1	Teach Courses with Improvements (Intervention 1)	3.3
	End of Year-1: Conduct Year-1 Measurement	
	Refine Course Interventions	
Year-2	Teach Courses with Improvements (Intervention 2)	3.4
	End of Year-2: Conduct Year-2 Measurement	

Table 1. Project Overview

3.2 Year-0: Develop and Freeze the Rubric
As discussed, we needed to measure the quality of the students' skills in a requirements elicitation interview. Because there were no published rubrics available in the literature, we needed to develop our own rubric from the ground up. After a thorough literature review and countless discussions, we decided on using a multifaceted and grounded approach that allowed various concepts to emerge organically. Periodically, we employed interpretive qualitative analysis techniques to gather and arrange our findings. A more thorough discussion of our methodological approach for developing this rubric can be found in Lending et al. (2022).

3.2.1 Develop Rubric Criteria. The design of a rubric contains rows that indicate the performance criteria that we want students to achieve. For this research, performance criteria were developed that identify what is needed to become a good requirements elicitation interviewer. To determine these criteria, we used two methods that consisted of analyzing content from an expert focus group and employing the use of multivocal and performance ethnography techniques (Lending et al., 2022). These two methods were conducted independently and then combined. They are summarized in Sections 3.2.2 and 3.2.3.

3.2.2 Focus Group Content Analysis. To gain a deeper understanding of requirements elicitation, the research team arranged for two subject matter experts to participate in a focus group. Both experts had over five years of experience in requirements elicitation and received professional training on the topic. The theme of the focus group session was to capture from these experts how they conduct requirements elicitation with an emphasis on interviewing, but the experts would be allowed to discuss requirements elicitation issues fully. The focus group format allowed the experts to talk freely on the subject, share ideas, and build on each other's conversation. The general focus group questions were provided in advance to the experts. An audio recording was made of the one-hour focus group session and institutional review board (IRB) procedures were followed. The key questions for the focus group were:

- How do you conduct requirements elicitation?
- What constitutes good requirements elicitation?
- What are the main components of requirements elicitation?
- Tell me about a time when requirements elicitation went well.
- Tell me about a time when requirements elicitation did not go well.

The outcome of the focus group session was an audio recording that was filled with the knowledge and expertise captured from our requirements elicitation experts. A transcription was shared with research team members who were not present at the interview. The content of the Word document was subjected to qualitative content analysis (Hsieh & Shannon, 2005) to identify the underlying meaning of the content found in the manuscript. An emphasis was placed on concepts discovered and discussed during the focus group session with less attention paid to word counts.

3.2.3 Multivocal and Performance Ethnography. In our second approach, we used actual student performances to drive the construction of the rubric. We used a multivocal ethnography technique (Tobin et al., 1989) where themes emerge from multiple levels of narrative. These narratives are told and retold from different perspectives. The multivocal ethnography technique was combined with performance ethnography (Alexander, 2005) where enactment performance is used as a method of inquiry. For this research, the client performers (interviewees) developed their role in advance and ad-libbed the performance in front of student performers (interviewers).

Client performers consisted of members of the research team playing the role of a user that needs a specific report from a new information system that is being developed. Teams of novice analysts (students at the end of a Systems Analysis and Design class) were assigned to interview the role-playing research team member. The role-playing research team member also served as a participant-observer in the ethnographic discovery process. The requirements elicitation constructs emerged by the participant-observers' immersion and observations in the interviews. All interviews were recorded and proper IRB procedures were followed. Finally, the research team met to define the criteria based upon the themes that emerged. The narratives were combined, argued about, and told and retold to develop a definitive list of criteria that showed the skills needed for conducting a requirements elicitation interview. In total, eight skills were found and form the rows of the rubric shown in Appendix A.

3.2.4 Develop Level of Performance Scale. To enhance scale reliability, outside learning-improvement experts were added to the development team and participated in multivocal ethnographic activities. The director of university assessment, an expert on developing rubrics, and the director of the university's faculty innovation center served as subject matters experts (SME). Both SMEs observed the focus group and watched two recorded student performances. They, along with the role-playing research team member that participated in all student interviews, developed the level of performance scale. As shown in Appendix A, a 5-point scale was developed and consisted of Beginner (1), Developing (2), Competent (3),

Excellent (4), and Outstanding Experienced Professional (5). As mentioned earlier, we expected our students to reach the competent level (3) by the time they graduated.

The rubric was initially anchored on two criteria points: Beginner and either Competent or Excellent. For example, for the criteria of an interview "Overview", Beginner performance was defined as "Provides no initial organization frame for the client." At this level, students typically begin interaction by launching into specific questions. No agenda, statement of purpose, or description of what the interview is to accomplish is included. Competent was defined as "Lays out agenda for meeting and indicates what should be accomplished in meeting." The researcher team then filled in the other three levels of performance using their knowledge from the focus group, ethnography, and work experience.

Subsequently, the five-member research team met and reviewed the rubric. In that meeting, the scale was discussed, refined, and changed. The definitions of the criteria were moved to the left side of the rubric, reducing the word count and improving the readability. To do a final test on the rubric, we required the entire team to view two requirements elicitation interview videos using the rubric to evaluate performance. After discussion, minor changes were made for usability and then the rubric was "frozen". A more thorough evaluation of the rubric shown in Appendix A can be found in Lending et al. (2018).

3.2.5 Conduct Baseline Measurement (Pre-Intervention).

To evaluate student performance with baseline measurements, a team of eight CIS faculty members were trained on the rubric. Faculty members used the rubric to produce scores by judging the RE interviewing skills of the various student teams on each rubric item by watching video recordings of the student team interview sessions. To promote inter-rater reliability, two videos representing a poor performance in one and a skilled performance in another were initially selected to calibrate ratings across the eight faculty raters. After further training, each faculty rater was then tasked to independently evaluate student performance using the rubric. The various faculty scores for each group were then averaged.

Eight student team interview videos were selected randomly from the available pool of recordings for each baseline year. Each recording randomly selected in the baseline year was then rated by two separate faculty members among the eight raters, leading to 16 faculty rating scores for each rubric item. Table 2 reports the mean rater score for each rubric item along with standard deviations for the baseline year. As shown in Table 2, the mean overall rating was 1.68, suggesting that faculty raters judged students 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.

The results shown in Table 2 were disappointing. For example, the students were measured in their systems analysis course and both instructors had just taught visualization techniques for eliciting requirements for reports the week before. The instructors used a textbook that included visualization of reports. The instructors used active learning exercises in class to practice the technique. Yet, when put in a more "real-world" requirements elicitation situation, just two of the thirteen teams used the technique that we thought they had learned. The teaching of requirements elicitation had to be refined.

Rubric Item	16 Ratings/Item	
	Mean	SD
Overview: Provide Organizational Frame	1.28	0.35
Analyze Current State "As Is"	1.81	0.68
Design "To Be" System	2.19	0.63
Offer Visualizations	1.06	0.24
Closing: Provide Appropriate Recap	1.53	0.70
Build Relationships	1.88	0.65
Listen Actively	2.03	0.82
Demonstrate Team Work	1.66	0.42
Mean Overall Rating	1.68	0.56

Table 2. Pre-Intervention (Year-0) Baseline Rubric Rating for Student Teams

3.3 Year-1: The Intervention and Measurement

Recognizing that we failed to teach RE adequately, Year-1 was a time to improve the teaching of many of the skills and concepts that leads to a successful RE outcome. These course changes or interventions were then followed by a second evaluation of student performance.

3.3.1 The Intervention. The CIS faculty, working together, created learning opportunities that crossed the entire program's curriculum. Activities began at a basic level in early classes and worked up to roleplaying activities in advanced classes. Because requirements elicitation is such a fundamental topic, learning activities were designed for most of the courses in the CIS curriculum. The activities were designed to build from one another following Blooms Taxonomy. Lower-level course activities centered on understanding and remembering. Middle course activities emphasized applying and analyzing, while advanced course activities focused on evaluating and creating.

Many techniques were used for improving learning of requirements elicitation. In a programming class, for example, the students often need to determine what a new system needs to do. So, at this time, the language of requirements elicitation was added to the programming class. In the enterprise architecture class, students were already working with the "as is" and "to be" architecture. Including language and activities around requirements elicitation was a natural addition to the course. Role playing activities and simulated interviews were added to classes where they made sense.

One learning activity performed by all of the students prior to their participation in a RE interview was to view a recorded interview and evaluate the interviewers with the rubric. This activity created familiarity with the features of the rubric and permitted the students to develop a deeper understanding of a competent interview performance. For a full description of the changes that occurred in our curriculum, refer to Ezell et al. (2019).

The choice of a rubric for measurement allowed us to use the rubric as a formative tool as well as a summative tool. The rubric in its entirety or in parts was shared with students throughout the curriculum. Students used the rubric to evaluate videos of other students interviewing, to evaluate their own performance, and to learn how to interview. Students reacted positively to using the rubric. Comments mostly emphasized

that the rubric provided a format and clarified what was truly needed to perform the requirements elicitation task.

3.3.2 Conduct Measure (Post-intervention). In Year-1, the interviews were repeated with a subsequent cohort of students at the same point in their college career and at the same point in the course. The case was different than the one used in Year-0, but the activities were similar (project planning, determining feasibility, requirements elicitation interviews, etc.). Interviews were recorded and evaluated using the same rubric. Once again, eight videos were randomly selected from the available pool of Year-1 recordings, and each video was rated by two separate faculty raters leading to 16 rating scores for each rubric item. Table 3 reports the mean and standard deviation of these scores along with baseline data (Year-0). Figure 1 shows these scores graphically for prima facie comparison. Because we do not have a true cohort system in our program, students may have been exposed to some courses prior to Year-1 interventions and some courses after Year-1 interventions. In all cases, the students were taught Systems Analysis and Design using Year-1 interventions. As shown in Table 3 and Figure 1, the mean overall rating increased significantly from Year-0 to Year-1.

Rubric Item	Year-0	Year-1		Change
	Mean	Mean	SD	
Overview	1.28	3.09	0.64	+1.81
As Is	1.81	2.84	0.72	+1.03
To Be	2.19	3.31	0.53	+1.12
Visualize	1.06	3.16	0.76	+2.10
Closing	1.53	2.69	0.86	+1.16
Relationship Building	1.88	3.25	0.53	+1.37
Active Listening	2.03	3.22	0.68	+1.19
Team Work	1.66	3.03	0.72	+1.37
Mean Rating	1.68	3.07	0.68	+1.39

Table 3. Comparison of Rubric Item Ratings for the Control (Year-0) and Experimental Groups (Year-1)
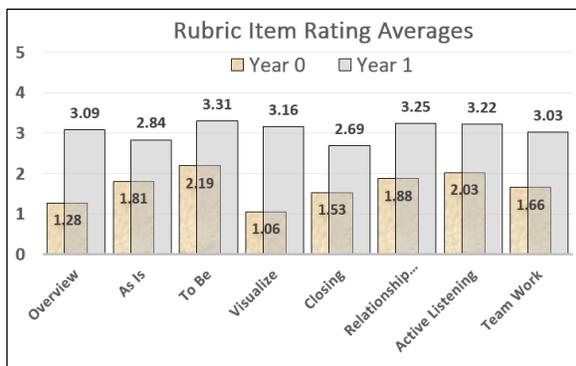

Figure 1. Comparing Rubric Item Ratings Before and After Intervention

3.4 Year-2: Second Intervention Year
The improved quality of the performance highlighted some remaining gaps in our teaching of RE interview skills. Between Year-1 and Year-2, we refined our teaching activities and continued the project. One of the major interventions was a focus on what we called the Pivot Problem. We noticed that groups who began their interview and headed in the wrong

direction were not always able to recognize the poor direction and pivot to the right one. As a result, we added activities to the Systems Analysis and Design class so that students could learn when they were heading down the wrong road and how to recover. Additional minor changes were made in other activities and other classes.

In Year-2, the interviews were repeated by a subsequent cohort of students at the same point in their college career and at the same point in the course. Interviews were recorded and evaluated using the same rubric. Again, because we do not have a true cohort system in our program, students may have been exposed to some courses prior to Year-2 intervention and some courses after Year-2 intervention. In all cases, the students were taught Systems Analysis and Design using Year-2 interventions. Once again, eight randomly selected student team interview videos from Year-2 were each rated by two faculty yielding 16 rating scores for each rubric item. Mean rating scores for all three study years are reported in Table 4.

Rubric Item	Year-0	Year-1	Year-2	
	Mean	Mean	Mean	SD
Overview	1.28	3.09	3.08	0.49
As Is	1.81	2.84	2.98	0.63
To Be	2.19	3.31	3.25	0.79
Visualization	1.06	3.16	3.31	0.69
Closing	1.53	2.69	2.92	0.80
Relationship Building	1.88	3.25	3.17	0.80
Active Listening	2.03	3.22	3.21	0.93
Team Work	1.66	3.03	2.87	0.73
Mean Rating	1.68	3.07	3.1	0.7

Table 4. Comparison of Rubric Item Ratings Across All Three Years of Study

A comparison of the three study years revealed that the mean overall rating was 1.39 points higher in Year-1 (intervention) than in Year-0 (pre-intervention). However, the mean overall rating of Year-2 was only 0.03 higher than Year-1. Additionally, all individual Year-2 ratings were within +/- 0.24 of those for Year-1. Figure 2 shows the comparison of student performance as assessed by the rubric between Year-0, Year-1, and Year-2.
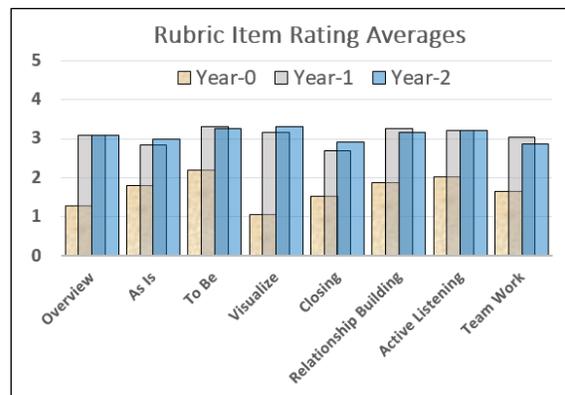

Figure 2. Comparing Pre-Intervention (Year-0) Performance with Year-1 and Year-2

4. DISCUSSION

The results of our multi-year project indicate that we have successfully developed a requirements elicitation interview rubric that can be used to measure and evaluate student performance. More importantly, we are confident that we have developed a rubric that can be used to improve student performance in conducting a requirements elicitation interview. The value of this rubric is both as an evaluation tool and a teaching tool. Suggestions on how to use the rubric as a teaching tool follow.

4.1 Using the Rubric as a Teaching Tool

It is important to give the students the rubrics early in the instruction so that students can internalize the methods and standards. Showing the students videotaped examples of good and poor work and letting them rate past interviews helps them see the big picture and to learn from the mistakes of prior students. Students will see that some groups do a good job on part of the criteria but not on all. Additionally, students will be motivated to conduct better interviews than past students and will subsequently be motivated to learn the material.

We used the same rubric over several courses so that students get to use the tool of RE interviews multiple times and with the same evaluation. This did not mean that every class had to use the whole rubric. In one class session or one course, an instructor could focus on a single criterion. For example, the "pivot," or recognizing when you are moving in the wrong direction and adjusting, was a difficult skill for students to learn. By designing exercises that focus on one criterion, students could improve that facet of their performance. In another class, the instructor could just focus on the visualizations needed to identify the requirements for the "to be" system.

Rubrics can tell us where we have a weakness in our teaching. For example, the week before the students were exposed to the rubric, the two professors of the Systems Analysis and Design courses taught about the use of visualization to determine requirements for user reports. Both professors were seasoned professionals who have won teaching awards. They used an active exercise in that class session so that students could experience how it was done. Despite this, very few of the students in the first cohort transferred the skill to their requirements elicitation interview when they were tasked with determining requirements for user reports. Yes, we taught them, but the students did not learn to use the skill. Using a visualization criterion on the rubric can help pinpoint this as a weakness.

Of course, to use this rubric in multiple classes implies that your department recognizes the skill of requirements elicitation and interviewing as fundamental to becoming an IS major. We did. But use in a single course such as Systems Analysis and Design would still improve student performance in that course.

4.2 Student Feedback

We received positive and unsolicited feedback from the students that used the requirements elicitation rubric. One student commented that during an internship training program, all of the interns in the organization were divided into teams of three and assigned the task of gathering requirements during an interview of a role-playing manager. The student's team finished first in the interview competition because, "No one else knew how to interview. I told my team members that I was taught how to interview in class. I emailed the rubric to the other two members of my team and taught them what was important. As a team, we were the best." Our student used the rubric to teach his team members, reinforcing the idea that a rubric may serve as a quality teaching tool.

Additionally, students commented that the rubric allowed them to successfully review and evaluate taped RE interviews. The rubric's eight distinct features (overview, as-is, to-be, visualization, closing, relationship building, active listening, and teamwork) helped to identify strengths and weaknesses. Yes, an interview may have a great opening and a great closing, but did the interview capture the requirements for the to-be system? The rubric directed the student interviewers to listen more carefully to the client because the rubric identified areas of importance.

Student comments did not always center on learning how to perform a requirements elicitation interview. Some comments focused on higher-level outcomes such as including "requirements elicitation interviews" on their resume. This often stimulated positive discussions with recruiters when interviewing for a job.

5. CONCLUSION

In this research, we started with the goal to improve student learning of requirements elicitation interviews in a Systems Analysis and Design course. After reviewing the literature, the outcomes of a focus group, and an ethnographic study, we successfully developed a rubric that was used for both a summative assessment (measure of performance at the end of a process) and as a formative assessment (used during the learning process as a teaching tool to improve student learning). To assess the effectiveness of this rubric at detecting improvements in the skills of our students during requirements elicitation interviews, faculty used the rubric to generate rating scores of student interview teams using videos of interviews from three study years. Descriptive statistics were generated for rating scores across all three study years and analyzed for improvement trends. The results of our analysis suggested that the development and use of our rubric improved the materials and learning activities used for teaching RE interviews. Additionally, the results suggested we significantly improved the performance of our students' ability to successfully elicit requirements via interviews. In the future, we will continue to refine this rubric to meet the changing needs of our students.

5.1 Limitations of This Research

One potential criticism of using a rubric as an instructional tool is that students are learning how to get a good grade on a particular assignment but are not necessarily learning or truly generalizing how to conduct a good requirements elicitation interview. We believe that we extend the generalization when the rubric is used at multiple times during the students' learning. We note that prior to use of the rubric, students did not generalize from an active learning exercise given the week before to the interview. Repeated use of the rubric in the curriculum did generalize to the interview. Additionally, anecdotal evidence shows that students used these techniques in their capstone course where the rubric was not taught or used, as well as in subsequent work experience. Still, this is an area for future research.

A potential criticism of our work is that there is nothing new in the rubric that is not included in a systems analysis textbook. What we add, however, is a framework that can be used for instructors to teach from and to evaluate student performance. We recommend the framework for students to learn. As Bolton (2006) points out, adult learners learn differently than younger learners. A rubric supports those differences by providing learners a performance outline and an understanding of what is important. It provides a student an approach to problem solving. For example, the rubric identifies that it is important to understand the current system and to work with the user together to develop the future system. It tells them that a visualization tool helps in the process of working together. With that in mind, students can develop the skill set to perform the creative activity of interviewing a user.

We note that a limitation of our work is that it is not a true experiment with subjects randomly assigned to a treatment group. Additionally, we have not eliminated other possible explanations for why one cohort of students may be different from another. Our results simply show that students subjected to the intervention performed significantly better than earlier students who were not given the intervention. Finally, our intervention is the combination of the use of a rubric as an assessment tool and as a teaching tool. An intervention that included only one of the two uses, might have differing effects.

5.2 Future Research
To demonstrate learning improvement, we "froze" the RE rubric once it had been completed pre-intervention. Both Year-1 and Year-2 were significantly better than Year-0 but appear similar to each other when examining the descriptive statistics. As faculty, we determined that the performance of students was in fact better for Year-2 versus Year-1. The rubric, however, did not reflect this visible improvement. After discussion, we hypothesized that the rubric was better at distinguishing beginning, developing, and competent performance than it was at distinguishing competent from excellent performance. This is understandable since at the beginning of our project we had few teams that met any competent criteria and could not use those examples to help develop the rubric. We revised the criteria to reflect such behaviors that we observed such as using the client's needs to drive the change, providing time to let the client think, and using visualization as a method for improvement rather than as an input to the interview.

Arter and McTigue (2000) recommend creating criteria in such a way that the criteria reduce a rater's having to toil while using the rubric. We recognized after a few years of use that rearranging some of the criteria on the page made it easier for the user of the rubric to evaluate a performance without searching the cells of the rubric during the interview. For example, explaining team roles was moved from team work to greeting and thus from the bottom of the rubric to the top.

Our revised rubric is shown in Appendix B. We have used this rubric successfully since the revisions. A natural next step for future research would be to use the revised version of the rubric over time to further evaluate its effectiveness as both an assessment tool for faculty and as a learning tool for students to improve their requirements elicitation skills. Additionally, future work can make efforts to revise the rubric so that it can more effectively detect differences in student performance at higher skill levels.

7. REFERENCES

Alexander, B. K. (2005). Performance Ethnography: The Reenacting and Inciting of Culture. In Lincoln, N. K. D. Y. S., & Lincoln, Y. S. (Eds.), *The Sage Handbook of Qualitative Research* 3 (pp. 411-442). Sage.

Ali, N., & Lai, R. (2017). A Method of Requirements Elicitation and Analysis for Global Software Development. *Journal of Software: Evolution and Process*, 29(4), e1830.

Alvarez, R. (2002). Confessions of an Information Worker: A Critical Analysis of Information Requirements Discourse. *Information and Organization,* 12(2), 85-107.

Andrade, H. G. (2000). Using Rubrics to Promote Thinking and Learning. *Educational Leadership*, 57(5), 13-19.

Andrade, H. G. (2005). Teaching with Rubrics: The Good, The Bad, and The Ugly. *College Teaching*, 53(1), 27-31.

Andrade, H., & Du, Y. (2005). Student Perspectives on Rubric-Referenced Assessment. *Practical Assessment, Research, and Evaluation*, 10(3), 1-12.

Appan, R., & Browne, G. J. (2012). The Impact of Analyst-Induced Misinformation on the Requirements Elicitation Process. *MIS Quarterly*, 36(1), 85-106.

Arter, J., & McTighe, J. (2000). *Scoring Rubrics in the Classroom: Using Performance Criteria for Assessing and Improving Student Performance*. Corwin Press.

Bano, M., Zowghi, D., Ferrari, A., Spoletini, P., & Donati, B. (2019). Teaching Requirements Elicitation Interviews: An Empirical Study of Learning from Mistakes. *Requirements Engineering*, 24(3), 259-289.

Basir, B., & Salam, R. (2015). Tacit Requirements Elicitation Framework. *ARPN Journal of Engineering and Applied Sciences*, 10(2), 572-578.

Bolton, F. C. (2006). Rubrics and Adult Learners: Andragogy and Assessment. *Assessment Update*, 18(3), 5-6.

Bormane, L., Gržibovska, J., Bērziša, S., & Grabis, J. (2016). Impact of Requirements Elicitation Processes on Success of Information System Development Projects. *Information Technology and Management Science*, 19(1), 57-64.

Browne, G. J., & Ramesh, V. (2002). Improving Information Requirements Determination: A Cognitive Perspective. *Information & Management,* 39(8), 625-645.

Costain, G., & McKenna, B. (2011). Experiencing the Elicitation of User Requirements and Recording Them in Use Case Diagrams through Role-Play. *Journal of Information Systems Education,* 22(4), 367-380.

Davey, B., & Parker, K. (2015). Requirements Elicitation Problems: A Literature Analysis. *Issues in Informing Science and Information Technology*, 12, 71-82.

Davis, A., Dieste, O., Hickey, A., Juristo, N., & Moreno, A. M. (2006). Effectiveness of Requirements Elicitation

Techniques: Empirical Results Derived from a Systematic Review. In the *14th IEEE International Requirements Engineering Conference (RE'06)* (pp. 179-188). IEEE.

De Ascaniis, S., Cantoni, L., Sutinen, E., & Talling, R. (2017). A Lifelike Experience to Train User Requirements Elicitation Skills. In the *International Conference of Design, User Experience, and Usability* (pp. 219-237). Springer, Cham.

Dennis, A., Wixom, B. H., & Tegarden, D. (2012). *System Analysis Design UML Version 2.0: An Object-Oriented Approach*, Fourth Edition. Wiley.

Dieste O, & Juristo N. (2011). Systematic Review and Aggregation of Empirical Studies on Elicitation Techniques, *IEEE Transactions on Software Engineering,* 37(2), 283-304.

Donati, B., Ferrari, A., Spoletini, P., & Gnesi, S. (2017, February). Common Mistakes of Student Analysts in Requirements Elicitation Interviews. In the *International Working Conference on Requirements Engineering: Foundation for Software Quality* (pp. 148-164). Springer, Cham.

Ezell, J. D., Lending, D., Dillon, T. W., May, J., Hurney, C. A., & Fulcher, K. H. (2019). Developing Measurable Cross-Departmental Learning Objectives for Requirements Elicitation in an Information Systems Curriculum. *Journal of Information Systems Education*, 30(1), 27-41.

Fancott, T., Kamthan, P., & Shahmir, N. (2012). Implications of the Social Web Environment for User Story Education. *Electronic Journal of e-Learning,* 10(1), 44-59.

Fernandes, J., Duarte, D., Ribeiro, C., Farinha, C., Pereira, J. M., & da Silva, M. M. (2012). iThink: A Game-Based Approach Towards Improving Collaboration and Participation in Requirement Elicitation. *Procedia Computer Science,* 15, 66-77.

Ferrari, A., Spoletini, P., Donati, B., Zowghi, D., & Gnesi, S. (2017, September). Interview Review: Detecting Latent Ambiguities to Improve the Requirements Elicitation Process. In the *2017 IEEE 25th International Requirements Engineering Conference (RE)* (pp. 400-405). IEEE.

Fulcher, K. H., Good, M. R., Coleman, C. M., & Smith, K. L. (2014). A Simple Model for Learning Improvement: Weigh Pig, Feed Pig, Weigh Pig. Occasional Paper #23. *National Institute for Learning Outcomes Assessment.*

Fulcher, K. H., Smith, K. L., Sanchez, E. R., Ames, A. J., & Meixner, C. (2017). Return of the Pig: Standards for Learning Improvement. *Research & Practice in Assessment*, 11, 10-40.

Gaikwad, V., & Joeg, P. (2017). A Case Study in Requirements Engineering in Context of Agile. *International Journal of Applied Engineering Research,* 12(8), 1697-1702.

Goguen, J. A., & Linde, C. (1993, January). Techniques For Requirements Elicitation. In *Proceedings of the 1993 IEEE International Symposium on Requirements Engineering* (pp. 152-164). IEEE.

Greenberg, K. P. (2015). Rubric Use in Formative Assessment: A Detailed Behavioral Rubric Helps Students Improve Their Scientific Writing Skills. *Teaching of Psychology*, 42(3), 211-217.

Havelka, D. (2003). A User-Oriented Model of Factors That Affect Information Requirements Determination Process Quality. *Information Resources Management Journal,* 16(4), 15-32.

Hersch, R. H., & Keeling, R. P. (2013, February). Changing Institutional Culture to Promote Assessment of Higher Learning (Occasional Paper No. 17). Urbana, IL: University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment.

Hickey, A. M., & Davis, A. M. (2003, September). Elicitation Technique Selection: How Do Experts Do It? In *Proceedings of the 11th IEEE International Requirements Engineering Conference* (pp. 169-178). IEEE.

Hickey, A. M., Davis, A. M., & Kaiser, D. (2003). Requirements Elicitation Techniques: Analyzing the Gap between Technology Availability and Technology Use. *Comparative Technology Transfer and Society,* 1(3), 279-302.

Hickey, A. M., & Dean, D. (1998). Prototyping for Requirements Elicitation and Validation: A Participative Prototype Evaluation Methodology. Paper presented at the *1998 Americas Conference on Information Systems (AMCIS)*, Baltimore, Maryland.

Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research,* 15(9), 1277-1288.

Jonsson, A., & Svingby, G. (2007). The Use of Scoring Rubrics: Reliability, Validity and Educational Consequences. *Educational Research Review*, 2(2), 130-144.

Kaloyanova, K. (2014). Information Systems Analysis and Design Course with Projects Based on Real Customers Requirements. Paper presented at the *Eighth Mediterranean Conference on Information Systems*, Verona, Italy.

Lending, D., Fulcher, K., Ezell, J. D., May, J., & Dillon T. W. (2018). Example of a Program-Level Learning Improvement Report. *Research & Practice in Assessment*, 13, 34-50.

Lending, D., May, J., Ezell, J., & Dillon, T. W. (2022). Discovering Effective Requirements Elicitation Techniques Using a Multivocal Ethnographic Framework. *International Journal of Innovation and Learning*, 31(2), 236-263.

Lipnevich, A. A., McCallen, L. N., Miles, K. P., & Smith, J. K. (2014). Mind The Gap! Students' Use of Exemplars and Detailed Rubrics as Formative Assessment. *Instructional Science*, 42(4), 539-559.

Pacheco, C., & Garcia, I. (2012). A Systematic Literature Review of Stakeholder Identification Methods in Requirements Elicitation. *Journal of Systems and Software,* 85(9), 2171-2181.

Pacheco, C., García, I., & Reyes, M. (2018). Requirements Elicitation Techniques: A Systematic Literature Review Based on the Maturity of the Techniques. *IET Software*, 12(4), 365-378.

Panadero, E., & Jonsson, A. (2013). The Use of Scoring Rubrics for Formative Assessment Purposes Revisited: A Review. *Educational Research Review*, 9, 129-144.

Popham, W. J. (1997). What's Wrong--and What's Right--with Rubrics. *Educational Leadership*, 55(2), 72-75.

Qurban, M. H., & Austria, R. D. (2009). Improving the Communication Skills of IS Developers during Requirements Elicitation Using Experiential Learning. *Journal of Information Systems Education,* 20(3), 301-311.

Ramiller, N. C., & Wagner, E. L. (2011). Communication Challenges in Requirements Definition: A Classroom Simulation. *Journal of Information Systems Education,* 22(4), 307-317.

Reddy, Y. M., & Andrade, H. (2010). A Review of Rubric Use in Higher Education. *Assessment & Evaluation in Higher Education*, 35(4), 435-448.

Regev, G., Regev, L., Naïm, Y., Lang, J., & Wegmann, A. (2015). Teaching an Ethnographic Approach to Requirements Elicitation in an Enterprise Architecture Course. In *Proceedings of the 1st International Workshop on Socio-Technical Perspective in IS Development (STPIS'15)* (pp. 5-19). CEUR Workshop Proceedings.

Saeeda, H., Dong, J., Wang, Y., & Abid, M. A. (2020). A Proposed Framework for Improved Software Requirements Elicitation Process in SCRUM: Implementation by a Real-Life Norway-Based IT Project. *Journal of Software: Evolution and Process,* 32(7), e2247.

Stevens, D. D., & Levi, A. J. (2005). *Introduction to Rubrics*, Sterling Virginia: Stylus Publishing.

Tobin, J. J., Wu, D. Y. H., & Davidson, D. H. (1989) *Preschool in Three Cultures: Japan, China, and the United States*, New Haven: Yale University Press.

Turner, J. (1990). A Comparison of the Process of Knowledge Elicitation with That of Information Requirements Determination. In Cotterman, W. W. & Senn, J. A. (Eds.), *Challenges and Strategies for Research in Systems Development* (pp. 415-430). New York, NY: John Wiley & Sons.

Unger-Windeler, C., Klünder, J. A. C., Reuscher, T., & Schneider, K. (2021). Are Product Owners Communicators? A Multi-Method Research Approach to Provide a More Comprehensive Picture of Product Owners in Practice. *Journal of Software: Evolution and Process,* 33(1), e2311.

Vijayan, J., & Raju, G. (2011). A New Approach to Requirements Elicitation Using Paper Prototype. *International Journal of Advanced Science and Technology,* 28, 9-16.

Vilela, J., & Lopes, J. (2020). Evaluating the Students' Experience with A Requirements Elicitation and Communication Game. In *Proceedings of the XXIII Ibero-American Conference on Software Engineering (CibSE 2020)* (pp. 526-539), Curitiba – Paraná (Brazil).

Watson, H. J., & Frolick, M. N. (1993). Determining Information Requirements for an EIS. *MIS Quarterly*, 17(3), 255-269.

Whitten, J. L., & Bentley, L. D. (2008). *Introduction to Systems Analysis and Design*. New York, NY: McGraw Hill Irwin.

Wong, L. R., Mauricio, D. S., & Rodriguez, G. D. (2017). A Systematic Literature Review about Software Requirements Elicitation. *Journal of Engineering Science and Technology*, 12(2), 296-317.

Zhang, Z. (2007). Effective Requirements Development-A Comparison of Requirements Elicitation Techniques. In Berki, E., Nummenmaa, J., Sunley, I., Ross, M., & Staples, G. (Eds.), *Software Quality Management XV: Software Quality in the Knowledge Society* (225-240), British Computer Society.

Zowghi, D., & Coulin, C. (2005). Requirements Elicitation: A Survey of Techniques, Approaches, and Tools. In Aurum A., & Wohlin, C. (Eds.), *Engineering and Managing Software Requirements* (pp. 19-46). Springer, Berlin.

Zowghi, D., & Paryani, S. (2003, September). Teaching Requirements Engineering through Role Playing: Lessons Learnt. In *Proceedings 11th IEEE International Requirements Engineering Conference* (pp. 233-241). IEEE.

AUTHOR BIOGRAPHIES

Diane Lending is a professor of computer information systems at James Madison University in Harrisonburg Virginia. Her doctorate is in Management Information Systems from the University of Minnesota. Her research interests are in information systems education and requirements elicitation. Dr. Lending has written papers published in several journals including *CIN: Computers, Informatics, Nursing*; the *Data Base for Advances in Information Systems*; the *Journal of Computer Information Systems*; and the *Journal of Information Systems Education*. Prior to joining academia, she was a programmer, systems analyst, and manager of systems development projects.

Jeremy D. Ezell is an associate professor of computer information systems and business analytics in the College of Business at James Madison University. He holds a Ph.D. in Information Systems from Auburn University. His research interests include organizational dynamic capabilities, organizational innovation, absorptive capacity, data quality, and requirements elicitation. Dr. Ezell has published in several journals including the *International Journal of Production Economics*, *Technometrics*, *Journal of Information Systems Education*, and *Computers and Industrial Engineering*.

Thomas W. Dillon is the PwC Donald F. Caputo Memorial Professor of Computer Information Systems at James Madison University in Harrisonburg, Virginia. He holds a Ph.D. in Information Systems from the University of Maryland, Baltimore County. Dr. Dillon currently teaches courses in Systems Analysis and Design, Enterprise Architecture, and IT Consulting. His research is in information systems applications in health care, IT ethics and privacy, and learning improvement in information systems. Dr. Dillon has published in several journals including the *Journal of Transportation Security; Journal of Computer Information Systems; CIN: Computers, Informatics, Nursing; Computers in Human Behavior; and Journal of Information Systems Education*.

Jeffrey May is an associate professor of computer information systems and business analytics in the College of Business at James Madison University. His doctorate is in Information Systems from Virginia Commonwealth University. His research interests include systems analysis techniques and frameworks, socio-organizational IS security, and Information Systems pedagogy. Dr. May's research has been published in several journals including *Decision Support Systems and Electronic Commerce,* the *Journal of Information Systems Education,* and the *Journal of Computer Information Systems*.

APPENDICES

Appendix A. Requirements Elicitation Interviewing Process Rubric

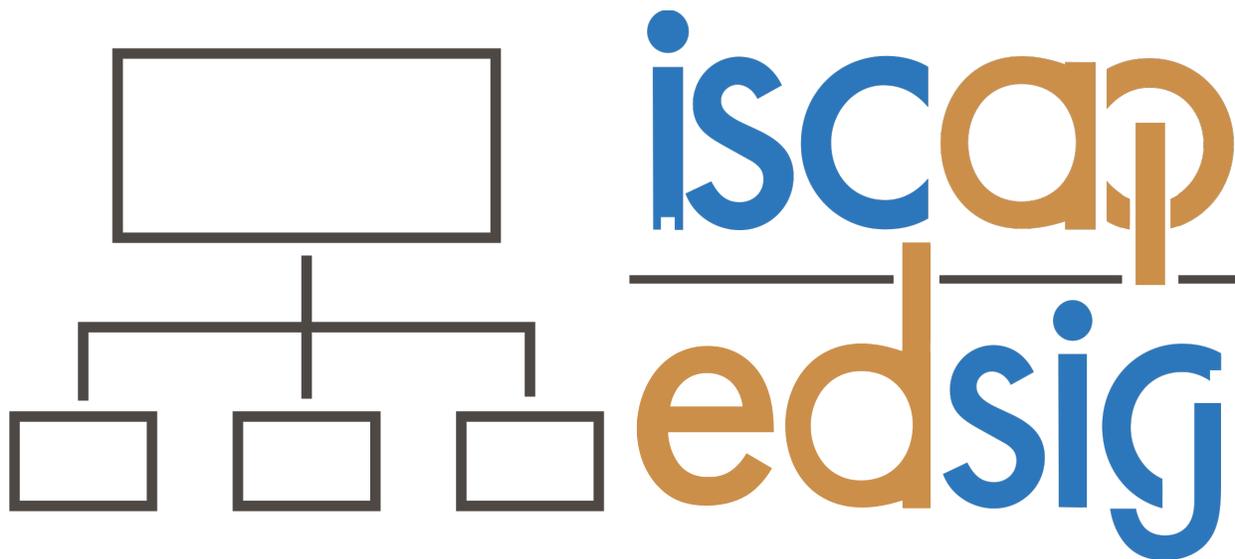| Requirements Elicitation Interviewing Process Rubric As of 6/28/2016					
	Beginner 1	Developing 2	Competent 3	Excellent 4	Outstanding experienced professional 5
Opening: Provides an organizational frame for the client, agenda, purpose, what hope to accomplish in the interview	Provides no initial organizational frame for the client. At this level, student typically begins interaction by launching into specific questions.	Provides some frame (e.g., starts out with some organizational sentences). May stay too broad (for example, "we are here to do requirement elicitation for your project") or provide some but not all of agenda, purpose, hope to accomplish.	Provides a complete organizational frame for the interview (agenda, purpose, hope to accomplish)	Meets criteria for Competent AND asks questions to determine type of client AND gets confirmation of frame from client AND adjusts accordingly	Meets criteria for Excellent AND delivers it smoothly. Clear, compelling, engaging are words that come to mind.
Analyze Current State: Understand current situation (e.g., *process, system, data, artifact*). Asks what is good and what's bad about current situation, process, system, or artifacts as appropriate.	No attempt to investigate the current situation. At this level, the student often starts by asking what the client wants; not what exists now.	Articulates the current situation. May be disorganized or out of context.	Mutual communication about the current situation. Asks what is good and what's bad about the current situation.	Meets criteria for Competent AND adds mutual discovery that *assists* the discussion.	Meets criteria for Excellent AND visualization guides the discussion. Examples of this may include an interactive exploration of the topic, mutual discovery, or an iterative process.
Design the To-Be System. Design the To-Be system with the client as part of the interview	No attempt to include the client in the design.	Asks client about the To-Be system using primarily closed ended questions OR Tells client what improvements will be and asks for opinion.	Works with client to design To-Be system. Team and client work out design together. Uses open-ended questions, and an interactive process.	Meets criteria for Competent AND client and team design together with appropriate mutual visualization, mutual discovery, and iteration.	Meets criteria for Excellent AND iteration is adaptive, probing, and explorative, with value added in each iteration. Keeps in mind scope of project or phase.
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.	Does not use visuals. Does not have or request a copy of current reports, screens.	Uses visuals that do not assist in discovering the requirements OR do not reflect client input in visuals. May refer to current artifacts or to-be artifacts.	Uses visuals to guide discovery of requirements.	Meets criteria for Competent AND uses draft or template visuals to guide relevant aspects of meeting. Client's input leads to a dynamic development of visuals during meeting.	Meets criteria for Excellent AND drawings are visible to all and all are welcome to contribute. Examples of this may include a mutual exploration of the topic, mutual discovery, or an iterative process.

	Beginner 1	Developing 2	Competent 3	Excellent 4	Outstanding experienced professional 5
Closing: Recap, plans next step, final questions.	Ends interview when done with questions.	Attempts closing but marred by one of the following: excessively long recap, closing focuses on relational aspects and not substance of the interview, closing focused on agenda not findings.	Recap of key points is on track and generally at the right level. Asks if any important issues were not discussed. Outlines future steps.	Meets criteria for Competent AND recap includes how requirements fit into the scope of project or project phase.	Meets criteria for Excellent AND uses artifacts created in the interview to guide the closing.
Relationship Building: appropriate greeting (stands up, shakes hands, introduces self, asks how the other is doing), eye contact, attentive, positive affirmation.	Interaction marred by one or more of the following: rude or condescending behavior, chronic lack of eye contact, chronic checking of phone, showing an overall lack of attention	Demonstrates some aspects of competent relationship building but may be inconsistent (for example, inconsistent eye contact or short periods of inattention)	Appropriate greeting. Questioner engages in appropriate eye contact. Displays positive affirmation.	Meets criteria for Competent AND is natural or smooth. Positive body language.	Meets criteria for Excellent AND sense an extraordinary professional relationship.
Active Listening: Pays attention, provides feedback, summarizes or paraphrases ideas, remembers past answers, asks for appropriate clarification.	Demonstrates minimal active listening techniques. For example, a questioner focused on questioning rather than on answers; or asking rapid questions without regard to prior conversation. May not listen to answer or talk over answers.	Demonstrates some active listening techniques. Question and answers are marred by some of following double-barreled questions, allowing client to not answer questions, asking questions that have already been answered, forcing client to give opinion when client does not know answer.	Uses active listening techniques (feedback, recaps, clarifications). Makes sure questions are answered, questions build on prior answers.	Meets criteria for Competent AND confirms understanding of the answer. Flexible in questions asked by adapting discussion dynamically based on understanding client's responses.	Meets criteria for Excellent AND Asks questions deliberately to gauge client type and gears entire style toward the client. Checks in frequently to ascertain common understanding.
Team Work (when applicable): To client, 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 team communication aids elicitation.	Each team member is operating on their own. May demonstrate visible dysfunction. Team members do not listen to one another.	Duties separated with each team member having different roles OR Team listens to each other and works together well BUT not both.	Each team member has different roles that they explain to the client. Roles are then demonstrated over the interview. Team listens to each other and works together well.	Meets the requirements for Competent AND team members refer to each other and add to what each other says in an appropriate way. Roles feel organic and natural.	Meets criteria for Excellent AND whole team performance feels strategic. Group synergy is better than sum of the individuals. The group develops and designs together; sharing different points of view.

Appendix B. Revised Rubric

Requirements Elicitation Interviewing Process Rubric As of 6/1/2017					
	Beginner 1	Developing 2	Competent 3	Excellent 4	Outstanding experienced professional 5
Getting Started					
Greeting: Appropriate greeting and small talk. Explanation of team roles. Breaks the ice and gets client and team talking to each other.	No attempt to make rapport.	Missing some of the components of competent but clearly attempts a greeting OR feels exceptionally awkward or rehearsed.	Shakes hands (or international equivalent), introduces team, appropriate small talk. Provides roles of team.	Relates roles to discovery of client problems. Makes clear that client needs are the center of this interview. Sincere interest in client problem. Provides context to the meeting.	Meets criteria for Excellent. Provides context to the meeting within project, network of people, or whatever is appropriate. Only award points in this area if it feels natural.
Opening: Provides an organizational frame for the client, agenda, purpose, what hope to accomplish in the interview	Provides no initial organizational frame for the client. At this level, student typically begins interaction by launching into specific questions.	Provides some frame. May stay too broad (e.g., "we are here to do requirement elicitation for your project") or provide some but not all of agenda, purpose, hope to accomplish.	Provides a complete organizational frame for the interview (agenda, purpose, hope to accomplish)	Meets criteria for Competent AND gets confirmation of frame from client AND adjusts accordingly. Provides client with an agenda to refer to.	Meets criteria for Excellent AND delivers it smoothly. Clear, compelling, engaging are words that come to mind. Asks questions to determine type of client.
Analyze As-is State: Understand the as-is situation (e.g., process, system, data, artifact). Asks what is good and what's bad about the as-is situation, process, system, or artifacts as appropriate. Uses this to reveal needs for the To-be.	No attempt to investigate the as-is situation. At this level, the student often starts by asking what the client wants; not what exists now.	Articulates the as-is situation. May be disorganized or out of context.	Mutual communication about the as-is situation. Asks what is good and what's bad about the as-is situation.	Meets criteria for Competent AND adds mutual discovery that *assists* the discussion and leads to the to-be design.	Meets criteria for Excellent AND visualization guides the discussion. Examples of this may include an interactive exploration of the topic, mutual discovery, or an iterative process.
Design the To-Be System. Design the To-Be system with the client as part of the interview. Uses the as-is discussion to lead into the to-be design.	No attempt to include the client in the design.	Asks client about the To-Be system using primarily closed ended questions OR Tells client what improvements will be and asks for opinion.	Works with client to design To-Be system. Uses open-ended questions, and an interactive process. Links back to as-is problems.	Meets criteria for Competent AND client and team design together with appropriate mutual visualization, mutual discovery, and iteration.	Meets criteria for Excellent AND iteration is adaptive, probing, and explorative, with value added in each iteration. Keeps in mind the scope of the project or phase. Client and team agree that design solves the problem.

	Beginner 1	Developing 2	Competent 3	Excellent 4	Outstanding experienced professional 5
Visualization: Uses appropriate visuals such as wireframe diagrams, interface structure, process models, current or to-be reports, visual mapping, written agenda, etc. to aid relevant aspects of meeting. Effectively integrates visuals into discussion.	Does not use visuals. Does not have or request a copy of current reports, screens.	Uses visuals that do not assist in discovering the requirements OR uses visuals as presentation aid not as a tool for problem discovery. May refer to current artifacts or to-be artifacts.	Uses visuals to guide discovery of requirements. Gets clients perspective on the visuals.	Meets criteria for Competent AND uses draft or template visuals to guide relevant aspects of meeting. Client's input leads to a dynamic development of visuals during meeting. Team provides meaningful feedback that encourages client to participate (e.g., changing reports or verbal recognition.)	Meets criteria for Excellent AND drawings are visible to all and all are welcome to contribute. Examples of this may include a mutual exploration of the topic, mutual discovery, or an iterative process.
Closing: Recap, plans next step, final questions. Closing reflects what happened in the meeting.	Ends interview when done with questions.	Attempts a closing but marred by: excessively long recap, focus on the relational aspects and not the substance, focus on the agenda not the findings, or closing does not reflect meeting.	Recap of key points is on track and generally at the right level.	Meets criteria for Competent AND asks if any important issues were not discussed AND outlines future steps.	Meets criteria for Excellent AND uses artifacts created in the interview to guide the closing.
Relationship Building/Holistic View					
Active Listening: Pays attention, provides feedback, summarizes or paraphrases ideas, remembers past answers, asks for appropriate clarification, eye contact, attentive, positive affirmation. If interview is on the wrong track, recognizes the issues and adapts.	Demonstrates minimal active listening techniques. For example a questioner focused on questioning rather than on answers; or asking rapid questions without regard to prior conversation. May not listen to answer or talk over answers.	Demonstrates some active listening techniques. Question and answers are marred by some of the following: double-barreled questions, allowing client to not answer questions, asking questions that have already been answered, forcing client to give opinion when the client does not know an answer.	Uses active listening techniques (feedback, recaps, clarifications). Makes sure questions are answered, questions build on prior answers.	Meets criteria for Competent AND confirms understanding of the answer. Demonstrates ability to adapt discussion or ask different questions based on client's responses.	Meets criteria for Excellent AND Asks questions deliberately to gauge client type and gears entire style toward the client. Checks in frequently to ascertain common understanding. Team is passionate about solving the client's problem.

	Beginner 1	Developing 2	Competent 3	Excellent 4	Outstanding experienced professional 5
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, have each other's back, and inter team communication aids elicitation.	Each team member is operating on their own. May demonstrate visible dysfunction. Team members do not listen to one another.	Duties separated with each team member having different roles OR Team listens to each other and works together well BUT not both.	Each team member has different roles that they explain or demonstrate over the interview. Team listens to each other and works together well.	Meets the requirements for Competent AND team members refer to each other and help each other with the interview. Roles feel organic and natural.	Meets criteria for Excellent AND whole team performance feels strategic. Group synergy is better than sum of the individuals. The group develops and designs together; sharing different points of view.

Information Systems & Computing Academic Professionals

Education Special Interest Group

STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the *Journal of Information Systems Education* have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.