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PREPARING INDUSTRY-READY ANALYSTS IN CLASSROOM: A MODULE INJECTION BASED APPROACH

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ABSTRACT

PREPARING INDUSTRY-READY ANALYSTS IN CLASSROOM: A MODULE INJECTION BASED APPROACH

Atiya Afsana

An analyst plays one of the most influential and important roles in an Information System Development (**ISD**) project, especially in the Requirements Elicitation (**RE**) phase of Requirement Engineering. Soft skills of an analyst role is in critical demand in the IT industry. A significant portion of researchers have also explicitly identified soft skill sets important for analysts. However, IS pedagogy and curriculum initiatives do not have any such systematic pedagogical approach that will be explicitly used for nurturing students with soft skills. Since there is a need, our initiative is to introduce a Behavioral Injection Module (BIM) approach. In traditional class lectures, we do not see any role-play simulation tasks or simulated practice session involved during the course. There is a need to practice interview question techniques for an analyst role in the class environment after the lecture contents. In particular, analysts need to simulate and practice the client-analyst requirement elicitation process and to improve certain soft skills in the process. This research presents a theoretical framework that uses the e-learning design principles of segmentation, role-play simulation and the Kolb's Experiential Learning Cycle mapping three soft skills to address the issues. We developed Behavioral Injection Module (BIM) that has two major components: lesson section and practice session. We provide our module description, our experimental design, the instruments we used and its outcome in this paper. We test the effectiveness of our BIM through experimental studies using courses of Computer and Information Sciences Department of Towson University.

We have conducted total five studies including the pilot study during spring 2015 and 2016, summer 2016 and spring 2017 semesters. We divided our participants into two groups: control and experiment. We then measured following constructs during the studies-

1) Individuals' soft skills (Communications, Perceptual and Thinking skills) evaluations using post survey.

2) Individuals' knowledge based skills (RE KL and Awareness on REKL) evaluations using pre and post survey.

3) Individuals' learning performance (transcript and report writing) evaluations using transcript and report.

A significant increase was found in learning performance ($p < 0.05$) and knowledge based skills (0.05) of the treatment group using our role-play simulation task of the BIM compared to traditional class lecture who did not participate in the role-play simulation. However, there was no significant difference found ($p>.05$) in soft skills development among the experiment group.

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1. Introduction

The rapid changes in Information Technologies (IT) has diversified the roles of Information System (IS) professionals (Lee, 2002; Lee & Lee, 2006; Yen, Chen, Lee, & Koh, 2003). In particular, the role of the analyst has increased in demand (Coughlan, Lycett, & Macredie, 2003; Chao and Shih, 2005; Lee & Lee, 2006). This has been both a challenge and an opportunity for information technology students.

An analyst plays one of the most influential and important role in an Information System Development (ISD) project, especially in the Requirements Elicitation (RE) phase of Requirement Engineering (Misic & Graf, 2004, Saiedian & Dale, 2000). Their job is to understand the problem and the user's needs and expectations for a proposed information system (IS). The social nature of IS careers or behavioral patterns have been considered to be important for the success of analyst. A significant portion of researchers have explicitly identified relevant behavioral skill sets important for analysts (Green, 1989; Nord & Nord, 1997Hunter & Beck, 1996; Lerouge & Blanton, 2005; Misic & Graf, 2004; Todd, McKeen & Gallupe, 1995; Wynekoop & Walz, 2000). Therefore, we see the skill requirement for an analyst is not only technical but also behavioral, including interpersonal, communication, knowledge networking, political skills, verbal & written skills, social and management skills (Green, 1989). The possession of such skill sets for an analyst is also equally critical for the requirement gathering phase of an ISD project. Current IS curriculum initiatives (Gorgone et al., 2003; Topi et al., 2010) have been providing the required technical knowledge in the classroom but they do not have any systematic pedagogical approach explicitly used for providing the students with behavioral skills (Chakraborty & Sarker, 2007). Given the importance of such behavioral skills in the

industry, it is necessary to develop behavioral skills in IS students. Therefore, it is important that IS academia need to design pedagogical tools focusing on behavioral skills. Using pedagogical tools, IS students should be able to enhance such skills through practice. This research proposes one such pedagogical approach that will help inculcate critical behavioral skills in IS students. In today's classroom environment, experiential learning approaches are typically semester long group projects. They come in various forms such as case studies (Tan & Philips, 2005), projects with real clients (Frandsen & Rhodes, 2002; Scott, 2006) and role-play simulation projects (Avison, Cole, & Fitzgerald, 2006; Chakraborty & Sarker, 2007; Sarker & Sahay, 2004). This proposed approach is more complimented with directed, short-term initiatives with a goal on how to prepare IS students for the industry by enhancing behavioral skills of an analyst and to contribute to IS education research by proposing a module injection based model.

The rest of the paper is organized in the following manner. First, we provide a brief review of research carried out on analyst behavioral skill sets, followed by existing IS pedagogy and experiential learning approaches. The next chapter discusses the research model and theory development followed by the description of our proposed Behavioral Injection Module. The subsequent chapters elaborate on the proposed methodology, experimental design, instruments and measurements, studies, its results and limitations of this research. Finally, discussion and contribution chapter is discussed.

1.1 Problem Definition

An analyst plays an important role in the Requirements Elicitation (RE) and Analysis phases of Requirement Engineering (Misic and Graf, 2004; Saiedian and Dale, 2000). Studies have indicated that analyst should possess both soft skills and technical

skills (Green, 1989; Hunter and Beck, 1993; Lerouge and Blanton, 2005; Nord and Nord, 1997). Thus, we can see the importance of having behavioral or soft skills for an analyst role. At the same time, educational institutions need to impart such skills among Information Technology (IT) students. However, the IT educational institutions and the curriculum have not changed as rapidly as industry. IT institutions also do not have the procedures to impart such soft skills in the classroom environment. Hence we see the following identified problems:

-Soft skill sets required by analysts are critical and has been now in demand in the Industry.

-A shortage of systematic procedures exists in IS curriculum and pedagogy that will impart such soft skills among IT students.

This research intends to explore, evaluate and propose a particular pedagogical approach that could address the above issues. This pedagogical approach involves behavior injection module (BIM) that includes active learning components such as background and laboratory assignments. The module injection approach has been adopted and integrated by various universities and several community colleges particularly in Information Security and introductory programming courses, to maximize the learning experience and to minimize the burden on the instructor (Taylor and Kaza, 2011; Nance and Taylor, 2012). Thus, the objective is also to enhance soft skills of the IT students through the exposure of the Behavioral Injection Module in the classroom environment. The premise of this dissertation is that if these behavioral modules were injected within the IS curriculum, it would a) develop certain industry-critical soft skills, b) improve the capabilities related to

key requirements engineering tasks. The dissertation intends to test this premise through empirical research guided by the following research questions:

Q1- Can students' soft skills be developed through the introduction of the role-play simulation task of the Behavioral Injection Module approach?

Q2- Can students' knowledge-based skills be developed through the introduction of the Behavioral Injection Module approach?

Q3- Can students' learning performance related to RE be improved through the introduction of the role-play simulation task of the Behavioral Injection Module approach?

We are also providing our following propositions for this empirical research:

P1: *The use of role-play simulation will have a positive effect on critical soft skills development for an individual.*

P2: *The use behavioral injection module will have a positive influence on the knowledge-based skills of an individual.*

P3: *The use of role-play simulation will have a positive effect on the learning performance of an individual.*

2. Literature Review

In order to provide the relevance of this research, a brief overview of the various existing literatures is presented in this section. We will focus specially on the importance of the soft skills that are necessary for analyst role, some example of soft skills and various academic pedagogical tools used for experiential learning.

2.1 Soft Skills Required by Analyst Role

At the heart of the Requirements Elicitation (RE) process lies the collaborative interaction between analyst and multiple stakeholders (Chakraborty, Sarker & Sarker, 2010; Ahmed, 2012; Vale, Albuquerque & Beserra, 2010). The process involves intense communication activities related to understanding the problem area, users, their needs, and how they operate within the context of the proposed system, and as part of organizational setting (Penzenstadler, Haller, Schlosser & Frenzel, 2009; Klendauer et al., 2012). In any ISD project, an analyst is responsible in assembling such problem requirements, persuading the clients, understanding what motivates individuals, displaying tact in dealing with individuals, presenting ideas in a manner easily understandable, and ensuring the requirements are met in the final system.

A significant amount of research has explicitly emphasized the importance of the relevant behavioral skill sets that the analysts need to possess in order to make any ISD projects effective and successful (Graf & Misic, 1994; Green, 1989; Hunter & Beck, 1996; Lerouge, Newton & Blanton, 2005). Behavioral skills have also been recognized as important prerequisite for performing requirement elicitation (Gottesdiener, 2002; Robertson & Roberstson, 2006). Green (1989) stated the importance of possessing soft skills of an analyst role for performance and for the effectiveness of project development.

Hevner & Mills (1995) in their research found behavioral skills to be as important as technical skills in order to get the right system requirements. Todd, McKeen & Gallupe, (1995) examined the changes in the knowledge and skill requirements of IS positions over a 20-year period 1970 - 1990. They found that the behavioral skills are as equally important as technical for an analyst role. Many other researchers have emphasized the similar importance of the non-technical skills for the IS professionals as they impact on the success and failures of any ISD projects (e.g., Lee, 2002; Misic & Graf, 2004; Lee, Trauth & Farwell, 1995; Todd, McKeen & Gallupe, 1995).

The terms 'soft skills', 'non-technical skills', 'people skills' and 'emotional intelligence' have been mentioned and used interchangeably quite a few times in the literature reviews and in the industry to refer to the behavioral skills (Ahmed, 2012; Penzenstadler et al., 2009). Many studies have defined behavioral skills. For example, Seetha (2014) defined soft skills as career traits such as leadership skills, communication skills, positive work attitude, teamwork skills, which every employees should possess. Renuga (2014) considered one who can communicate effectively, can get along with others, can embrace teamwork, can take initiative, and possess strong work ethics, to have a proficient set of soft skills. Soft skills are "communicative abilities enhancing the efficiency in interactions" (Niemeyer, 2006, p.15). Certain literatures has referred 'behavioral skills' as a combination of interpersonal, communication, leadership, social, political, and verbal & written skills (Green, 1989; Hunter & Beck, 1996; Cappel 2002; Todd et al., 1995; McMurtrey et al. 2008; Schreiner, 2007; Lee, 2002; Vale et al. 2010; Ahmed, 2012). Since the RE process involves lots of interactions and explorations for the new system requirement, analyst needs to possess such type of skills to handle the process

and to ensure the complete and accurate requirements are being collected for the final system. Therefore, we can see why soft skills have been considered to be important for the analyst both in the industry and in the literatures. Next, we discuss various exemplar soft skills, their definitions and their level of importance.

Any exchange of messages with the different stakeholders in the process of requirement elicitation is regarded as interaction or communication. On the other hand, communication skills are the set of skills that enables a person to convey information so that it is understood and perceived (Kushal & Ahuja, 2009). An analyst needs to have such capabilities to do discussions, interviews with the stakeholders, to speak clearly, concisely and listen actively to create clear, complete and usable documentation of the new system. Research has emphasized the importance of having such communication skills for an analyst. For example, Hunter and Beck (1996) investigated the profile of an excellent analyst and identified twelve (12) themes, which constitute the qualities of an excellent analyst. The twelve themes were right attitude, knowledge, communicate effectively, plan, investigate, flexible, thorough, design, experience, involve user, delegate and creative. Among these themes, more emphasis has been given to the communication skills over others. Lee (2002) reported communication skills and industry specific knowledge for analysts are dominating in the context of a study conducted with IS professional from Singapore. Similarly, Bassellier & Benbasat (2004), DeSouza et al. (2009) and Ahmed (2012) stated the importance of the interpersonal and communication skills among analyst. Curtis et al. (1988) interviewed with various IS professionals and stated the importance of communication skill for both interactions between the analyst and the stakeholders, and analysts and developers. On the same lines, McCubbray and Scudder (1988) determined

that communication and organizational skills are important for analyst. In similar fashion, the study of Lee, Trauth and Farwell (1995) suggested the industry demand of IS professionals will increase in multiple dimensions, particularly in interpersonal, management skills and business functional knowledge. Maxwell (1988) proposed that successful analyst must have people-oriented skills, personal practices and technical competencies. Many other researchers have also stated the similar importance of possessing communication skills for an analyst during the requirement phase (Becker et al., 1993; Penzenstadler et al., 2009; Kovitz, 2003; Paech, 2008).

Similar way, interpersonal skills have been recognized to be an important skills for an analyst role. Hayes (2002) defined this skill as an ability where an individual can do face to face interactions in order to bring about a desired state of affairs. Lerouge et al. (2005) ranked this interpersonal skill higher in terms of importance given in their need to interact with individuals associated with an IS project. Thus we can see that any kind of face to face interaction with different stakeholders can be referred to as either communication or interpersonal skill. In our research, we will be emphasizing on nurturing communication skills of IS students which is an important skill for an analyst to possess for the requirement elicitation process.

Some researchers have found an association of the human characteristics, behavior, and cooperation with practical software development (Lerouge et al., 2005, DeSouza et al., 2009 and Klendauer et al., 2012). Analyst sometimes need to persuade and motivate tactfully, without being blunt to the individuals or clients, while eliciting requirements in a project. According to Lerouge et. al. (2005), any kind of action of persuasion or coercion or organizational change or conflict is referred to as Political skills. The job of analysts

should possess diplomacy, leadership, and political skills besides speaking, writing, and management skills to make any projects successful (Green, 1989; Nord and Nord, 1997; Wynekoop and Walz, 2000).

In fact, importance of analytical, thinking or problem solving skills have also been stated by a number of researchers as an important skill set that an analyst requires to deal with the problem complexities of ISD projects (Hunter and Beck, 1996; Wynekoop and Walz, 2000; Todd et al., 1995). Ahmed (2012) defined analytical skill as the ability to break down a situation into chunks, recognize what needs to be done, and plan and workout in a step-by-step manner. Problem solving skills have been defined as the ability to identify and evaluate a solution that will meet the customers' needs (Ahmed 2012). Similarly, Misic and Graf, (2004), Cappel (2002) and Ahmed (2012) reported that strong analytical and problem solving skills, followed by technical, communication, and interpersonal skills are required to be possessed by successful analysts. Misic and Graf (2004) found analytical skills overall to be the most important skills for an analyst, followed by technical and communication skills. An analyst also needs to prepare written documents during the requirement elicitation phase. The analyst needs to write those documents in such a manner that is easily understood by the intended readers and reflect the proper problem definition of the project. Thus writing capability is equally important for an analyst (Green, 1989; Cappel, 2002; McMurtrey et al., 2008). According to Vale et al. (2010) and McMurtrey et al. (2008), written communication were among the most important personal skills to IT professionals.

In certain circumstances, analyst also requires the capability to organize, plan, work in team, promote the system, share the knowledge, and persuade others to accept the

viewpoint during the requirement elicitation phase of any ISD project. These skills enable IT professionals to interact and work with their business peers in order to find business processes (Bassellier & Benbasat, 2004). Lee, Trauth & Farwell (1995) studied the impact of changes in the IS profession on the critical skills and knowledge requirements on future IS professionals. The study later reported that the industry will demand IS professional to possess business operations, management, and interpersonal skills. Wade and Parent (2002) found organizational skills such as ability to work in teams and with end users, managers, etc. to be more important for analysts than technical skills. Bassellier and Benbasat (2004) emphasized on leadership and knowledge sharing capability. Nord & Nord (1997), Klendauer (2012) and Green (1989) mention diplomacy, leadership, political, and sales skills as necessary to possess for analyst besides other soft skills. Similarly, DeSouza et al. (2009), Bassellier and Benbasat (2004) and Ahmed (2012) stated the importance of the knowledge networking possession of IT professionals besides communication skills.

While the studies have mentioned a number of soft skill sets of an analyst role and have also highlighted perceptual differences in the discernment of relative importance, they are essentially similar to some extent and can be largely categorized (Nord and Nord, 1997). Such categorization is useful in identifying a more specific set of soft skills and applying them to the pedagogical context of this dissertation. Therefore, for this research, we have categorized some soft skills such as communication, social, interpersonal, behavioral, verbal and written skills into one broad category named as Communication Skills. Also, we have combined soft skills like high order or critical thinking, problem solving, analytical skills into one category named Thinking skills. Finally, the

Management Skills category refers to the combination of organizing, team building, leadership, management, diplomacy, political and sales skills. Based on the literature reviews that we have conducted, we can thus see three broad categories of the soft skills Thinking skills, Communication skills and Management skills. Table 1 shows the different exemplar soft skills resulted from the studies under these three main categories.

Table 1: Exemplar Soft Skills

Articles	Thinking Skills	Communication Skills		Management Skills
Bassellier& Benbsasat (2004)		Interpersonal, Communication	Knowledge Networking	Leadership
Lee, Farwell & Trauth (1995)		Interpersonal		Management
Green (1989)		Behavioral	Political, Diplomacy	
Lerouge Blanton & Cheney (2005)		Interpersonal	Political, Social	
Hunter & Beck (1996)	Problem Solving	Verbal & Written		
Wynekoop & Walz (2000)	Problem Solving	Communication		Leadership
Todd, McKeen & Gallupe (1995)	Problem Solving	Social		Management
Davis (1982)		Communication		
Curtis, Krasner & Iscoe (1988)		Communication		
Leitheiser (1992)		Interpersonal, Communication		
Becker, Carmel & Hevner (1993)		Communication		
Hevner & Mills (1995)		Communication		
Misic &Graf (2004)	Problem Solving	Interpersonal, Communication		
Nord & Nord (1997)		Interpersonal	Diplomacy	
Wade and Parent (2001)		Communication		
Lee (2002)		Interpersonal		Management
Cappel (2002)	Problem Solving	Verbal & Written		
Browne & Ramesh (2002)		Communication		Management
Kovitz (2003)		Communication		
Schreiner (2007)		Communication		

Paech (2008)		Communication		
McMurtrey, Downey, Zeltmann & Friedman (2008)	Problem Solving	Verbal & Written		
Penzenstadler & Schlosser (2009)		Communication	Social	
DeSouza, Sharp, Singer, Cheng & Venolia (2009)		Communication		
Vale, Albuquerque & Beserra (2010)	Problem Solving	Verbal & Written		
Ahmed (2012)	Problem Solving	Interpersonal, Communication		
Klendauer (2012)	Problem Solving	Interpersonal, Communication	Social	Management, Leadership

We also see a good amount of correspondence in the categorization of these soft skills with that of the Boyatzis & Kolb's Learning Skills Profile (LSP). Kolb's Learning Cycle is one of the most influential theories in pedagogical perspective and contains four interactive components (Yamazaki, 2010; Rainey et al, 1993). The classification of Boyatzis & Kolb's LSP is in accordance with Kolb's Learning model (Yamazaki, 2010). We adopted Boyatzis & Kolb's LSP as there is a correlation exists with our broad categorization of the soft kills. The LSP of Boyatzis & Kolb's are Interpersonal Skills, Perceptual or Information Skills, Analytical Skills and Behavioral or Action Skills.

Each skill can be nurtured through Kolb's Learning Cycle (discussed in details in Chapter 3). Analytical skills involve the capacity of thinking to solve a problem or to make a decision. Perceptual/Information Skill is a skill where the new information are perceived, grasped and analyzed to make it comprehensible. Developing leadership quality, creating relationship and helping each other comprises the Interpersonal Skills (Kolb, 1984; Boyatzis and Kolb, 1995; Rainey et al., 1993). Finally, the Behavioral or Action Skills are capabilities that allow an individual to set goals and systematic plans, take initiatives and perform actions or the tasks. In Table 2, we have shown the mapping of each Boyatzis &

Kolb's LSP to the analyst capability skills using the representative research. We have used this taxonomy to identify the critical skill sets of an analyst in an attempt to link and align it with a pedagogical perspective.

Table 2: Correlation of the Soft Skills with Boyatzis & Kolb's Learning Skills Profile

Articles	**Correlation of the Soft Skills with Boyatzis & Kolb's Learning Skills Profile**			
	Communication Skills	**Perceptual/ Information Skills**	**Thinking Skills**	**Behavioral/ Action Skills**
Bassellier & Benbsasat (2004)	✓	✓		
Lee, Farwell & Trauth (1995)	✓			✓
Green (1989)	✓			
Lerouge Blanton & Cheney (2005)	✓			
Hunter & Beck (1996)	✓	✓	✓	
Wynekoop & Walz (2000)	✓	✓	✓	
Todd, McKeen & Gallupe (1995)	✓	✓	✓	✓
Davis (1982)	✓			
Curtis, Krasner & Iscoe (1988)	✓			
Leitheiser (1992)	✓			
Becker, Carmel & Hevner (1993)	✓			
Hevner & Mills (1995)	✓			
Misic &Graf (2004)	✓	✓	✓	
Nord & Nord (1997)	✓			
Wade and Parent (2001)	✓			
Lee (2002)	✓			✓

Cappel (2002)	✓	✓	✓	
Browne & Ramesh (2002)	✓			✓
Kovitz (2003)	✓			
Schreiner (2007)	✓			
Paech (2008)	✓			
McMurtrey, Downey, Zeltmann & Friedman (2008)	✓		✓	
Penzenstadler & Schlosser (2009)	✓			
DeSouza, Sharp, Singer, Cheng & Venolia (2009)	✓			
Vale, Albuquerque & Beserra (2010)	✓		✓	
Ahmed (2012)	✓		✓	
Klendauer (2012)	✓		✓	✓

We chose Kolb's learning cycle to map our activities for the module injection since it is a holistic model of the learning process, and it also aligns the soft skills requirements in IS to a pedagogical context. Based on the mapping of this (shown in Table 2), we see that the soft skills categories identified through the Kolb's cycle can be mapped with the behavioral skills mentioned by the research in IS. With the context of the four skills of Boyatzis & Kolb's LSP, we will neither be using the term 'behavioral or action skills' nor measuring it in our experiment. However, we used the term 'behavioral skills' to refer 'soft skills' or 'non-technical skills' in general throughout our paper. We have used both the behavioral skills and soft skills in this paper. We will be only focusing on nurturing three soft skills which are thinking skills, perceptual or information skills and communication skills that are pertinent to the Boyatzis and Kolb's LSP. These soft skills can be nurtured

in different modes of Kolb's cycle. Later in the section, we discuss how we incorporated different activities of our Behavioral Injection Module with that of the Kolb's learning cycle.

2.2 IS Pedagogy and Experiential Learning

The aim of Information System (IS) curriculum and pedagogy is to prepare students for a career in an expanding field. The literature review in the previous section has helped us to understand how industry needs particularly with respect to non-technical or soft skills of IS profession analyst, have changed over the past decades. Academic institutions are usually responsible for graduating IS students with the necessary skills so that they can succeed in a rapidly changing technological environment. Currently, IS curriculum initiatives (Gorgone et al., 2003; Topi et al., 2010) have been providing the required technical knowledge in the classroom environment, and they have incorporated different effective pedagogical methodologies and experiential learning tools within various IS courses. These methodologies and learning tools help IS students to provide experience in complex IS projects, to impart any knowledge or to develop any skills in the classroom environment. This section examines such examples of IS pedagogy approaches, benefits of experiential learning, its usage and types, certain teaching and learning strategies that are being used in the past and current literatures.

The word 'Experiential' means anything learned from experience. Experiential Learning takes on a various forms. They range from realistic group case studies (Tan and Phillips, 2005), projects with real clients (Frandsen and Rhodes, 2002; Scott, 2006) to role-play simulation based projects (Avison, Cole, and Fitzgerald, 2006; Chakraborty and Sarker, 2007; Sarker and Sahay, 2004, Heim et al., 2005). Group projects, or such

collaborative learning tools, help IS students to provide experience in complex systems development projects. That is why IS educators have opted for group projects or other forms of collaborative learning within their courses (Jones and McMaster, 2004; Tetard and Patokorpi, 2005)). Group projects also lead to the development of cognitive and interpersonal skills (Livingstone and Lynch, 2000). It has been shown that certain behavioral skills such as communication, personal, interactive and teamwork skills can be developed if the students work in a team based project involving real-world context problems (Chakraborty and Sarker, 2007; Jones and McMaster, 2004; Tan and Phillips, 2005; Jensen and Wee, 2000).

Fox (2002) introduced case studies related to real-world system development, to IS students to prepare them to be successful in their careers. Although these case studies were occasionally challenging and sometimes difficult to manage, it offered a useful opportunity to develop the communication and team work skills for the students. In other studies, for example, Mukherjee (2004) introduced Class Exercises to promote higher-order thinking or analytical, oral and written skills. Massey et al. (2005) used Active Learning as a pedagogical technique to engage the class actively in mastering the concepts and thus improve communications skills. The technique was comprised of jeopardy games and crossword puzzles.

While these different pedagogical tools such as case study, real-world projects, class exercises, etc. have some usefulness, they also have few drawbacks. Specifically, researchers argue that they are difficult to manage (Fox, 2002; Tan and Philips, 2005) and hard to find multiple real projects with similar scope and complexity (Jensen and Wee, 2000). Also, the instructors of the courses require considerable amount of effort,

involvement, and preparation for the projects (Fox, 2002; Tan and Phillips, 2005). Currently, these projects are typically associated with capstone courses and limited to semester long group works. Due to these drawbacks, students are subsequently exposed to very few of such endeavors. Such problems associated with 'real projects' have been mitigated with the use of role-play simulations (Avison, Cole, and Fitzgerald, 2006). The objective of using role-play simulated activities is to gain an understanding of complex, dynamic social systems by playing roles (Gredler, 1996 & 2004). It is one of the most important techniques in experiential learning (Vincent and Shepherd, 1998). Role-playing and simulations are frequently used in disciplines such as in teaching Politics in Middle East, Economics, Law and Medicine as means for professional training (Vincent and Shepherd, 1998). In South Africa, case studies and role-play business simulations have been used frequently in accounting discipline as means for professional training (Merwe, 2013). These learning strategies helped to develop generic professional skills such as teamwork, communication, and writing skills required for the workplace (Merwe, 2013). The importance of role playing have also been emphasized to impart system analysis and design education to IS undergrad students by Chakraborty and Sarker (2007) and Kirs (1994). In the class room environment, it has been proven to make students more engage, fun and thus improve their behavioral and communication skills (Avison, Cole, and Fitzgerald, 2006). Wagner (2004) introduced the idea of Action Memos that permits role-play to teach Information Systems Management concepts. Action Memos are mini-cases which create realism, demanding a response, usually in the form a decision or an opinion and thus help to develop problem-solving skills. Soft skills like communication, self-confidence, teamwork, problem solving, organizational ability and leadership can be

developed by using real-world problem (Thomas and Busby, 2003). Xu and Yang (2010) used business simulation to make students think in strategic ways, solve complex problems and integrate knowledge across business functions thus improved problem-solving skills.

Even though, role-play simulation has been used intensively as an effective pedagogical methodology, there is still a need of an intervention approach that would provide students with multiple exposure within a semester or across the IS curriculum. The approach would also be easy to implement and handle. One such approach that could provide the means to rectify this issue is module injections (Taylor and Kaza, 2011). Modules are self-contained laboratory assignments which have been formatted to allow simple insertion/injection within a lab or for stand-alone use (Turner, Taylor and Kaza, 2011). They come with active learning components such as background, laboratory assignments, checklist, and discussion session to promote critical thinking, collaborative learning and reflection. The module injection approach has been adopted and integrated by various universities and several community colleges particularly in Information Security and introductory programming courses, to maximize the learning experience and to minimize the burden on the instructor (Taylor and Kaza, 2011; Nance and Taylor, 2012). Turner et al. (2011) and Taylor and Kaza (2011) have used the module injection approach to promote collaborative learning, student's retention capability, understanding and the awareness of the concepts. As we have seen how the different soft skills have been fostered in different literatures using the different experiential tools, in this research, we will be using such module injection approach as a pedagogy tool. Our Behavioral Injection Module will comprise of interactive dialogue system and role-play simulation activities. ISD projects typically represent complex social system and role-play activities in the module

will be a suitable mode of instruction for preparing IS students to become effective analysts. We feel that such directed, short term initiatives would acquaint students with the typical analysts' requirement elicitation task of an ISD projects. Table 3 below shows how soft skills has been impacted or developed using different experiential learning tools such as role-playing and module injection.

Table 3: Different IS Pedagogy Learning Approaches and Skill Impact

Articles (Author, Year)	Soft Skills	Experiential Learning Techniques
Gredler, 1996 & 2004	Social skills	Role-play
Kirs, 1994	Interpersonal and communication skills, improve their attitudes towards learning, group problem solving	Role-play
Jensen & Wee, 2000	Behavioral and Communication skills, Active learning, Cognitive skills	Role-play
Fox, 2002	Communication skills and team skills	Real-world projects
Thomas and Busby, 2003	Communication, self-confidence, teamwork, problem solving, organizational ability and leadership	Real-world problem
Wagner, 2004	Problem solving capability and bring realism	Using Action memos that permits role-play
Avison, Cole & Fitzgerald, 2006	Analytical / Thinking Skills, Real world context, Analysis and Conceptual skills	Case Studies, Videos, Games, Debates-Role play simulation
Chakraborty & Sarkar, 2007	Cognitive, communication, Interpersonal Skills	Role-play simulation
Merwe, 2013	Generic Professional skills in accounting field-like teamwork, communication, and writing skills	Case study method and business simulations including Role-plays
Taylor & Kaza, 2011	Critical thinking, collaborative learning & reflection	Module Injection Approach
Nance & Taylor, 2012	Collaborative learning, awareness, and retention of the concepts	Module Injection Approach

In our subsequent sections, we discuss the key elements of this dissertation including the research model, the hypothesis, the methodology, the experimental design, data analysis and their results along with the measurement instruments.

3. Theoretical Development

In this section, we discuss our research model, the theory of Kolb's learning cycle, how we are mapping to three soft skills, and the critical tasks in requirement engineering.

3.1 Conceptual Research Model

Figure 1 presents the conceptual research model used to guide this research. Our research model suggests that the mental intellectuals of an individual is generally influenced by pedagogical techniques. There are three things in our research that we are interested: Soft skills, Knowledge-based skills and Learning Performance of an individual. Soft skills will be operationalized in terms of Communication Skills, Perceptual skills, and Thinking Skills of the general technology students. Knowledge-based skills will be operationalized in terms of RE knowledge and Awareness on RE Knowledge. And Learning Performance will be operationalized in terms of Requirement Elicitation (RE) Task Competency and Requirement Quality.

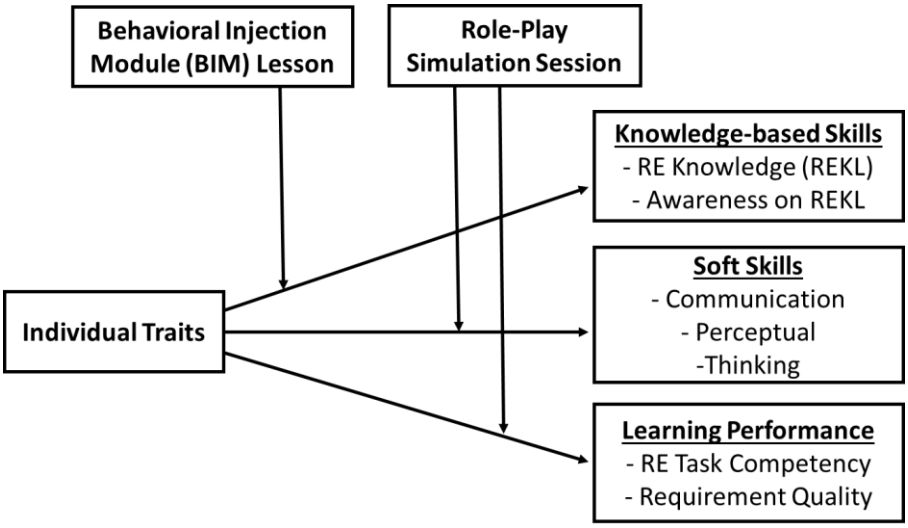

Figure 1: Conceptual Research Model

We also feel and have seen in various literatures that pedagogical techniques such as role-play simulation, group work, etc. have a role to play (Avison, Cole, and Fitzgerald,

2006; Chakraborty and Sarker, 2007; Sarker and Sahay, 2004, Heim et al., 2005). Specifically, we suggest that pedagogical technique that contains role-play simulation task would moderate the relationship between the individual and learning performance and soft skills. In particular, we feel that our Behavioral Injection Module (BIM) with a practice session would lead to better learning performance and soft skills if included in the traditional lecture based instructions. Along with it, the BIM itself would lead to overall better knowledge-based skills. Therefore, based on our research model, we have come up with the following major (H1, H2 & H3) hypothesis along with their sub level ones-

- H1- Critical Soft skills demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-paly simulation
    - H1a: Individuals participating in the role-play simulation will have better communication skills than those not participating in the role-play simulation.
    - H1b: Individuals participating in the role-play simulation will have better perceptual skills than those not participating in the role-play simulation.
    - H1c: Individuals participating in the role-play simulation will have better thinking skills than those not participating in the role-play simulation.
- H2 – Individuals will demonstrate higher levels of knowledge-based skills after interacting with the Behavioral Injection Module
    - H2a: Individuals will demonstrate higher levels of RE KL after interacting with the Behavioral injection module.
    - H2b: Individuals will demonstrate higher levels of Awareness on RE KL after interacting with the Behavioral injection module.

- H3 - Task competency demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-play simulation
    - H3a: Individuals participating in the role-play simulation will generate better transcripts than those not participating in the role-play simulation.
    - H3b: Individuals participating in the role-play simulation will generate better quality report than those not participating in the role-play simulation.

3.2 Background Theory for BIM

3.2.1 Kolb's Learning Theory

There are many educational frameworks used in higher education to facilitate student engagement in learning and enhancing skills. We chose to use Kolb's Experiential Learning Framework to plan and design our learning module. It is a frequently cited educational framework and has been used particularly in management, nursing, marketing, medicine, geography, psychology literature (Healey, 2000; Konak, 2014; Kosir, 2008; Gibbs, 2010). The theory, which is also known as the learning cycle, provides a guideline on how a session or a whole course may be taught to improve student learning. Kolb suggests that the learning takes place in a cyclical manner and it comprises four modes as shown in Figure 2. The cycle begins with the Concrete Experience (CE) mode. In CE mode, information is perceived or grasped through experience. The next mode is Reflective Observation (RO), where any kind of revision or reflection on the gathered experience takes place. In the Abstract Conceptualization (AC) mode, conclusion from the past and present experience is drawn using theories and models. Finally, in the Active Experimentation (AE) mode, things are put into practice from what have been learnt and understood and are put into plans and actions. The comprehensive learning outcomes of a

student can be nurtured by constructing learning sequences that lead student through this Kolb's Learning Cycle (Svinicki and Dixon, 1987). An individual can enter at any point of the cycle and sequentially develop specialized abilities and preferences for their learning. Each stage or mode of the cycle is associated with distinct learning skills. Boyatzis and Kolb (1991, 1993 & 1995) collectively called these skills as the Learning Skills Profile, shown in Figure 2. There are four skills that are developed and are associated with the four learning modes of Kolb's learning cycle. In the CE mode, information skills are nurtured as there are lot of reading, grasping or gathering of new knowledge or new experience take place. Here the learner gathers new information and analyzes them. In the RO mode interpersonal skills are developed as the learners are revising the gained experiences or background information about a particular topic. As there is lot of thinking involves in analyzing a particular given task or solving a problem, which tends to develop the thinking or analytic skills in the AC mode. Finally, the learners get into actions or do experiments on gathered knowledge which then tends to develop the action skills in AE mode (Passarelli, 2011; Kolb, Boyatzis and Mainemelis, 2001). In our research, we will only focus on the first three skills: information, communication and analytical skills.

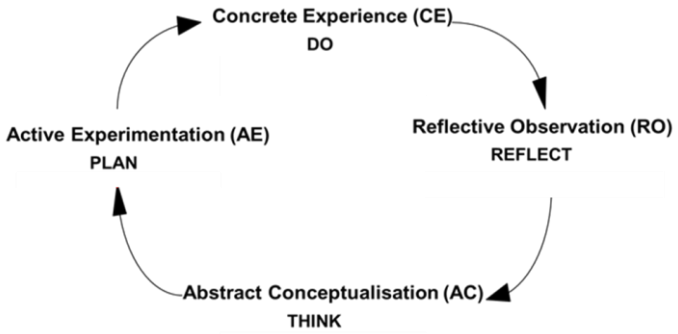

Figure 2: Kolb's Experiential Learning Cycle and Learning Skills Profile (Adapted from Boyatzis & Kolb, 1991; Konak, Clark, & Nasereddin, 2014; Yamazaki, 2010)

According to the Learning Skills Profile, Interpersonal Skill has been referred to leadership, any kind of relationship and help skills (Boyatzis and Kolb, 1991, 1993 & 1995). Since interpersonal skills involves social interactions, part of it implicit within this is communication skills. We will focus on developing the communication skills among IS students for our research and will observe how well the students practice their communication skills to collect the requirements in the RE process by playing role of analyst and users in the activities. Skills that required any kind of information gathering, sensing, grasping or processing is being referred to as Perceptual Skills or Information skills (Boyatzis and Kolb, 1991, 1993 & 1995). We will also focus on developing the perceptual or information skills among IS students for our research and will observe how well the students gather RE knowledge from the lesson plan. Analytical skills has been referred to as technology, quantitative, thinking and theory building skills (Boyatzis and Kolb, 1991, 1993 & 1995). We will focus on developing the thinking skills too, among IS students for our research and will observe how well the students practice their thinking skills while preparing the requirements elicitation tasks and the requirement specification document. Taking initiative to do certain tasks, actively doing, performing or experimenting, or setting goals for an action are combined together to refer as Behavioral skills (Boyatzis and Kolb, 1991, 1993 & 1995).

This research aims to develop Behavioral Injection Module that apply Kolb's learning cycle. We incorporated the cycle in our module in a way that it would not only help the general technology students to develop their learning performance and the soft skills but it would also improve the quality of requirement elicitation process.

3.2.2 Critical Tasks in Requirements Elicitation (RE)

A fundamental phase of information system development (ISD) projects is information requirements elicitation (RE). The analyst plays the influential and important role in the Requirements Elicitation phase (Saiedian and Dale, 2000; Graf and Misic, 1994). Requirement elicitation phase involves collecting and presenting the clients' needs and expectations for a proposed information system (IS). The analyst is responsible for assembling such problem requirements, persuading the clients, understanding what motivates individuals, displaying tactfulness in dealing with clients, presenting ideas in a manner easily understandable, and ensuring the complete and accurate requirements are met in the final system. One common strategy for a complete requirements elicitation for an analyst is to interview the clients (Browne and Rogich, 2001). Interviews need to be conducted in a structured manner to elicit the specifications and functionalities of the new system otherwise analyst will often results in asking wrong questions or omitting important questions. To avoid asking wrong questions and to collect missing information, the analyst uses various types of prompts to stimulate the user's thought processes. There are many directed prompting questioning schemes such as interrogatories or syntactic prompting technique, semantic prompting technique, context-dependent and context–independent questioning method (Browne and Rogich, 2001). These prompting techniques in general cover all categories of questioning for the requirement elicitations. The analyst uses this technique as guidance for constructing questions. Once requirements have been collected from the clients, the analyst still faces an immediate problem. And that is to establish a point at which the requirements elicited are sufficient to continue with the system development effort (Pitts and Browne, 2004 and Browne and Pitts, 2004). Browne and

Rogich (2001) has used the taxonomy of generic requirements from Byrd et al. (1992) as a useful tool for such problem. This taxonomy covers the general types of knowledge such as goals, processes, tasks and information about a new information system, that analyst need to understand and apply.

Our Behavioral Injection Module incorporates the important concepts of requirements elicitation process and prompting techniques to increase the knowledge of the overall requirements analysis process among the students in the classroom environment. We have developed such lesson plans that will not only allow the students to gather knowledge in overall requirement elicitation process but also inculcate in them the proper interview questioning techniques and to use the taxonomy for termination of information acquisition in the role-play simulation process. Therefore, the improvement of such analyst questioning can be a catalyst for the software development process and beneficial to IS development efforts. We are expecting that our Behavioral Injection Module approach in entirety will increase the quality of the requirements analysis of the students in the classroom environment.

4. Behavioral Injection Module (BIM)

This chapter discusses about the description of our Behavioral Injection Module (BIM) and how we have adapted the Kolb's Learning Theory in our module.

4.1 Module Description

Our Behavioral Injection Module (BIM) combines pedagogical tools with a simulated RE environment to facilitate student learning. We will conduct this experiment in various general technology courses. The BIM consists of lesson part and practice session part. The topics related to Requirement Elicitation presented as lesson modules in the form of a webpage. Students are expected to follow and complete each step of the lesson module. The practice session of the BIM is composed of dialogue system to practice RE questions techniques. In this session, students will perform role-play simulation task of the analyst-client role. Students are expected to follow and complete each step of the practice session. The description of each steps of the BIM has been discussed in the following:

First Step: The class will take a preliminary survey. The survey contains the demographic and basic RE knowledge related questionnaires. It takes less than 10 mins to complete the pre-survey. This survey helped us to examine the certain variables of the knowledge-based skills of the individual.

Second Step: The students will read the lesson content using the website link or web address of the BIM. The lesson will provide basic information related to RE process, prompting techniques and the taxonomy.

Third Step: After successfully reading the content, individual will take a small quiz. The quiz helps to examine the certain variables of the knowledge-based skills of the individual.

Fourth Step: The next activity of the BIM is the practice session. First the website provides a brief lesson on the dialogue system, what it is and how to use it. After reading the information, the individual clicks to the link to access the automated dialogue system page. Dialogue system will be used to practice question techniques and to elicit requirements for the given sample case study. This automated dialogue system is a type of Question Answer (QA) system. It gives users the ability to engage in a natural language, human-like conversation (Litman and Silliman, 2004; Lu, Cheng and Yang, 2012; and Augello et al., 2012). Users simply type natural language questions and the system provides short answers in natural language (Augello et al, 2012). Dialogue system has been in use in many existing researches to simulate real world activities and for easy follow-up and clarifications questions (Quarteroni and Manandhar, 2007; Roussinov et al., 2008; Chang et al., 2013; Augello et al., 2012). In our context, the interaction with the dialogue system is thus simulating an environment in which an analyst could ask questions to elicit system requirements. The questions included in the dialogue system's domain are based on a prompting technique, which covers all categories of questioning for the requirement elicitations. Individual will elicit the requirements for the assigned case study, by asking proper questions to the dialogue system. This whole process is the role-play simulation of an analyst and a user to elicit the requirements in this experiment. Students will collect the practiced questions with responses and use them later for report preparation. Here, we name the practiced questions with responses as Transcripts. Once they are done practicing, they move to the next step.

Fifth Step: The students will write a requirement specification report. In this step, the class will be provided with a requirement specification template designed to allow the

individuals to document the system specifications collected from the dialogue system during their practice. The document template will have a list of questions related to the system specifications. The individual needs to fill up the answers that they will be prompting from the dialogue system. That is they will use the transcript that has the corresponding responses to the practiced questions. After they finished practicing the report writing, they will move on to the next step. This activity helped us to examine the certain variables of the learning performance of the individual.

Sixth and Final Step: After report writing, the individuals asked to take a post-survey. The individuals convey their experiences gained from the practice and the usage of the overall activities through the survey. This survey helped us to examine the certain variables of both the knowledge-based skills and soft skills of the individual.

4.2. Mapping Module to Kolb's Learning Theory

We adapted Kolb's Learning Framework to develop our Behavioral Injection Module. Our module is self-contained and will be introduced within IS courses. In this section, we describe how this module is actually using the Kolb's theory. Based on the theoretical aspect of Kolb's cycle, the mapping of the different activities of the injection module with that of Kolb's learning cycle has been presented in Table 4. The students will perform each activity and are expected to develop three soft skills in the process mentioned under the 'Skill Impact' column of Table 4. We have shown step by step the practical applications of the theory below and how each step entails the development of those three soft skills.

Table 4: Mapping with Kolb's Learning Cycle

Application	Activities	Kolb's Learning Cycle Stages	Skill Impact
Behavioral Injection Module	Step: 1 Reads background information about RE topics.	Concrete Experience (CE)	Information Skills
	Step: 2 Take Quiz	Reflective Observation (RO)	Information Skills
	Step: 3 Practice the question technique using the dialogue system.	Active Experimentation (AE)	Communication Skills Thinking Skills
	Step: 4 Prepare RE Specifications document (report).	Abstract Conceptualization (AC)	Thinking Skills Information Skills

Step 1 Mapping: In this step, students will read the lesson plan of the BIM to get a grasp or general knowledge about the overall RE process, questions techniques and stopping rules. This activity is associated with the Concrete Experience stage of the Kolb's learning cycle. Here, the students are gaining a basic concept of the subject topic which eventually leads to the development of the perceptual or information skills. As they are gaining some new information about a particular topic, we are pertaining this type of knowledge gathering as perceptual or information skills.

Step 2 Mapping: At the end of the reading task, the students take part in quiz which help them to reinforce the knowledge they gathered. This quiz-taking task is pertaining to reflective observation stage.

Step 3 Mapping: The activities in this step associates with the Active Experimentation stage of the Kolb's learning cycle. The individuals in this step will use the dialogue system to simulate the environment of asking questions to the clients (in this case asking to dialogue system). This kind of interaction with the dialogue system simulating the environment of analyst asking correct questions to the clients. As this step

employs simulations, it associates with the Active Experimentation stage of the cycle. Individuals in this stage will practice the RE process by asking questions to the system to elicit the requirements for the given case study. As they practice more and more, they tend to retain the information firmly. The interactivity that takes place between the individual and the dialogue system in this step, tends to nurture students to develop such communication skills. According to Boyatzis & Kolb's Learning Skills Profile, interpersonal skills constitute leadership, relationship and help skills. But, from our context, we are more interested to observe how well the requirements analysts interact or communicate. Therefore, we are focusing on this communication skill which is one of the parts of the interpersonal skills as stated in the various literatures for our experiment (Green, 1989; Hunter and Beck, 1996; Cappel 2002; Todd et al., 1995; McMurtrey et al. 2008; Schreiner, 2007; Lee, 2002; Vale et al. 2010; Ahmed, 2012; Kushal and Ahuja, 2009; Hayes, 2002).

Step 4 Mapping: This process drives individuals to think critically, to solve the given problem. The individuals are provided with a requirement specification template and a case study. They are asked to fill out the template with answers collected from the dialogue system. Once they fill out, they prepare a report about the case study. This activity corresponds to the Abstract Conceptualization stage of the Kolb's learning cycle. As they are preparing for writing the report, the individual go through different thought process and also reflect back on what they experienced or practiced, reinforcing the concepts. This leads to develop their mental mode or thinking skills. Once they are done with practicing and writing the report, they will take a short survey.

5. Methodology

5.1 Instruments and Measurements

In our experiment, we measure the learning performance, knowledge-based skills and soft skills of both groups. Our measuring variables and their corresponding instruments that we used for the experiment shown in Table 5. All the items were measured using an interval like scale ranging from 1 to 5.

Table 5: Measuring Variables and their Instruments

Factor	**Measuring Variables**	**Instruments**	**Description/Source of candidate measures**
Knowledge-based Skills	Awareness on RE Knowledge	Quiz Questions type	Instructor will develop Quiz; Adapted from Chakraborty, 2008
	RE Knowledge	Survey Questionnaires	Explicit IT Knowledge and Tacit IT Knowledge (Bassellier, Benbasat and Reich 2001) Technical Knowledge (Lee, Trauth and Farwell 1995)
	Application of Knowledge	Survey Questionnaires	Adapted from Chakraborty Dissertation paper
Learning Performance	RE Task Competency	Transcripts, Report	Bailey & Pearson, 1983
	Requirement Quality	Report (on accuracy, completeness, conciseness, relevance, creativity and consistency,)	Using judge's scores; Adapted from Bailey & Pearson, 1983; http://www.jstor.org/stable/2631354
Soft Skills	Perceptual Skills	Survey Questionnaires	Adapted from Chakraborty, 2008
	Thinking Skills	Survey Questionnaires	Multi-rater instrument measuring problem solving skills (Lohman 2004)
	Communication Skills	Survey Questionnaires	Interpersonal Skills (Bassellier and Benbasat 2004; Lee, Trauth and Farwell 1995)
	Demographic Attributes	Survey Questionnaires	Adapted from Wade & Parent, 2002

Appendix A and C list all the instruments and their items. The overall difference between the two post-surveys will help us to determine or assess the effectiveness of our role-play simulation task of the Behavioral Injection Module. Figure 4 displays the timeline

along with the possible measurement variables that has been measured in different times during our experiment for both experimental and control group.

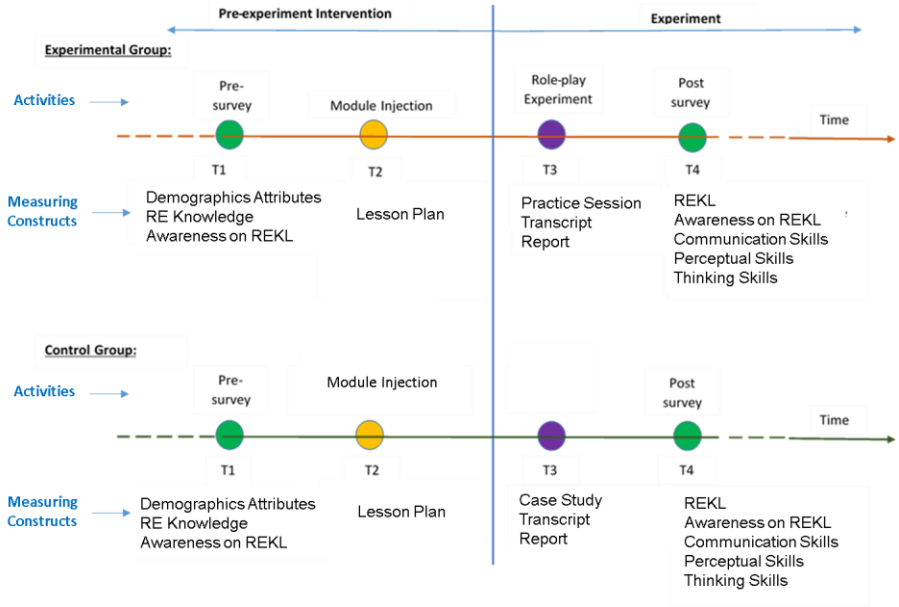

Figure 3: Measurement Variables Timeline for Experimental and Control Groups

We have pre-survey at the beginning of the intervention where we measure the demographics attributes and knowledge based skills of the students. Then for the experimental group, we administered the practice session of Behavioral Injection Module whereas the control group has the lesson component on the similar topic with no practice session. The control group received the same case study as the experiment group. During the intervention of the module and the role-play simulation task, we measured various factors as shown in Figure 3.

The various artifacts that we used to measure the learning performance are the transcripts and the reports. From transcripts, we assess interview question techniques and from the report, we assess the requirement quality. We measure the transcript quality based on the Questions Depth, Questions Breadth, Questions Prompts, Questions structuredness

and Questions order. The instructor use these grading items to grade the transcripts. Table 6 shows the details about each measuring items.

Table 6: Rubric for Transcripts (adapted from Brown & Rogich, 2001)

Items	**Details**
Questions Depth	Number of questions practiced
Questions Breadth	Number of questions practiced in all four levels
Questions Prompts	Number of attempted substantive and procedural prompts
Questions structuredness	Questions asked in sequence: goal, process, task and information
Questions order	Questions asked in order: first a substantive prompt followed by a procedural prompt

The Requirement Quality measured based on its on accuracy, completeness, relevance and consistency. Class instructor assess the reports generated by the participants and based on the rubric, we were able to evaluate the Requirement Quality (refer to Table 7). The various artifacts that we used to measure the knowledge-based skills are the RE knowledge and the Awareness on RE Knowledge. We have questionnaire items for RE Knowledge and quiz for Awareness on REKL. From the post-survey we assess the development of the soft skills of the participants before and after the exposure to the practice session. We also have questionnaires for three soft skills.

Table 7: Rubric for Report (adapted from Bailey & Pearson, 1983)

Items	Possible Points (20)
Accuracy	5
Completeness	5
Relevance	5
Consistency	5

The question techniques that we used for dialogue system, was adapted from Bryd et al (1992) and Browne and Rogich (2001). BIM's lesson content was adapted from Couger (1996) who recommended a questioning technique for gathering requirements based on interrogatories, e.g., who, what, where, when, why and how. We have examined the various existing instruments for measuring our constructs through pilot study to check whether or not they are appropriate to use in the context of our research. The entire instrument is presented in Appendix C. Our next chapter discusses the overall design of the experiment and the pilot study.

5.2 Overall Experimental Design

We conducted our experiment during the normal semester. Our participants were the Information Technology students. In our study, we have a control group and an experiment group. Both groups receive lesson component of the Behavioral Injection Module. Only the Experimental group exposed to the role-play simulation task of the Behavioral Injection Module. In the process, we measure the knowledge-based skills within each group and the development of soft skills between the two groups after the

exposure of our injection module and the practice session. We observe any improvement of the learning performance from the report writing and transcript.

Due to the variances in teaching style of the different instructors, we conducted our experiment both as in-class and online assignment in different semesters. We had to adjust our experimental design and the lesson contents to accommodate the availability of the time frame and the nature of the assignment. We conducted a total of five studies including the pilot study. The details of each activities that the groups had performed during the experiment, the various instruments that we used for measuring different constructs and the results of the data analysis with the conclusion are discussed in each study sections.

5.3 Pilot Study 2015

We conducted a preliminary in-class data collection to test our approach. Even though our goal is to conduct the experiment among IS students, we did not get enough IS classes and so we conducted our pilot study in classes of Computer and Information Sciences (CIS) department at Towson University. We conducted our pilot study in the following courses during Fall 2015 semester: COSC111, COSC601 and COSC432 (see Table 8). All of these classes were treated as experimental group and thus the individuals were exposed to the full BIM that is both the lesson and the practice components. Our experimental design for the in-class pilot study is shown in Table 9.

Table 8: Fall 2015 Classes for Pilot Study

Fall 2015 Classes	Tested Variables	Activity Type
COSC111-450	Demography, Interest on RE Knowledge, Awareness on RE, Usability & Satisfaction	In-class
COSC111- 101	Demography, REKL, Interest on REKL, Awareness on RE, Absorption of REKL, Usability & Satisfaction	In-class
COSC432 & COSC601	Usability & Satisfaction	In-class

Table 9: Experimental Design and Measuring Variables for Pilot Study Fall 2015

Items	Pilot Study Activities	Time Limit	Measuring Variables
Pre-Survey	Step 1: Take a Pre-Survey	10mins	Knowledge-based Skills: Demography, REKL, Interest on RE Knowledge and Awareness on REKL
Pedagogical Intervention (in-class tasks)	Step 2: Read the lesson section of the BIM	20mins	
	Step 3: Practice interview questions with dialogue system	20mins	Learning Performance: RE Task Competency (Interpretation of responses from Transcripts; quality of interview questions prepared & Interpretation of responses) Role-play simulation of user (dialog system) & analyst (participants)
	Step 4: Generate requirement specifications report	10mins	Learning Performance: Requirements Quality
Post-Survey	Step 5: Take a Post Survey	10mins	Knowledge-based Skills : RE Knowledge, Absorption of KL, Awareness on RE KL Usability & Satisfaction

During the pilot study, we tested the following constructs: knowledge-based skills, usability and satisfaction of the BIM. Before conducting the study, we prepared a list of questions to check whether our BIM is feasible or not and whether it is running smoothly or not. After the pilot study, we identified the following answers. We made the necessary adjustments to our module design based on this pilot study.

- Was it easier or harder than we thought the study was going to be?: It was harder. The website content was too long and confusing. The items on both pre and post surveys were very extensive and time consuming. We identified that certain items were unnecessary and repeated in both the website content and on the surveys. We fixed those items in the survey questionnaires. We also updated the module website.

- Did it take longer than we thought it was going to?: It did take longer than we expected. We later had to fit the module content and the survey items within the given class hour.

- Did participants behave in the way we expected?: It did to a certain extent. Our observations were as follows:

a. Participants were copying each other's work.
b. Participants shared their questionnaire answers.
c. Some participants were reluctant to answer the questionnaires as it was too extensive
d. Participants who came late or who are slow in compare to the rest of the class were not familiar what was going on. Later, we decided to have a proper instruction and a brief introduction to our BIM.

- Did the whole experiment process behave in the way we expected?: Not at this time. So we had to adjust our whole BIM with the class time.

The following section discusses about the reliability test conducted over all the measuring constructs and their respective results.

5.3.1 Reliability Test

We have developed questionnaires for each measuring constructs: REKL, Interest on RE KL, Awareness on REKL, Absorption of REKL and Usability. To determine the degree to which all the items are measuring the same construct, we chose Cronbach's alpha. Cronbach's alpha is one of many tests of reliability. Before a questionnaire can be valid, it must be reliable. Cronbach's alpha is a measure of internal consistency. We took average of the items for each participants and compute the total score of all the items for each participants. Then we ran the reliability tests for all the constructs. The results are shown in Table 10. From the table, the Pearson Correlation[1] column shows the strength of the linear relationship and the Cronbach's alpha[2] column shows the measure of scale reliability. Based on the value of the Cronbach's alpha, a comment has been made under Comment column of Table 10.

[1] Generally, correlations with an absolute value greater than 0.7 are considered strong, Correlations with an absolute value less than 0.3 are considered weak. Correlations with an absolute value between 0.3 and 0.7 are considered moderate.

[2] A value of 0.8 is seen as an acceptable value for Cronbach's alpha. Values substantially lower indicate an unreliable scale.

Table 10: Reliability Test of Fall 2015 Constructs

Measuring Constructs	Inter-Item Correlation	Reliability Test			
	Pearson Correlation	**# of Participants**	**# of Items**	**Cronbach's Alpha**	**Comment**
RE Knowledge	medium to strong correlation exists	26	5	0.92	very high reliability
Awareness on REKL	weak correlation exists	26	6	0.05	low reliability
Interest on RE	medium to strong correlation exists	26	6	0.82	high reliability
Absorption of RE KL	weak correlation exists	25	10	0.14	low reliability
Module Usability	medium to strong correlation exists	86	13	0.91	very high reliability
Satisfaction w/Module	medium to strong correlation exists	90	4	0.88	high reliability

The five items on RE Knowledge questions were recorded from 1 to 5 on a five point Likert scale 1 representing 'Not at all' and 5 representing 'Extremely' (See Table 11 for sample survey questions and Table 12 for the Likert Scale). The REKL questionnaire was designed to predict how much REKL the participants had gathered after using the lesson component of the BIM. A reliability test was conducted to test the internal consistency of the survey. The Cronbach's alpha, for five-item RE Knowledge questions, was found to be 0.92, which suggested good internal consistency. The survey was administered online on student voice.

Table 11: Sample REKL Survey Questions

RE Knowledge Sample Survey Questions	
1	Rate your Knowledge about Requirements Elicitation (RE) process.
2	Rate your Knowledge about Prompting Techniques.
3	Rate your Knowledge about Analyst Tasks.
4	Rate your Knowledge about the critical Soft Skills needed by an Analyst.
5	Rate your Knowledge about the value of interviewing techniques for eliciting requirements.

The six items student awareness on RE Knowledge questions were recorded. A reliability test was conducted to test the internal consistency of the survey. The awareness on REKL questionnaire was designed to predict how much the participants are aware on REKL after using the lesson component of the BIM. The Cronbach's alpha, for six-item awareness on RE Knowledge questions, was found to be 0.057, which suggested weak consistency. The survey was administered online on a student voice.

Table 12: Sample Likert Scale for REKL

Likert Scale	**#**
Not at All Knowledgeable	1
Slightly Knowledgeable	2
Moderately Knowledgeable	3
Very Knowledgeable	4
Extremely Knowledgeable	5

The six item student interest on RE Knowledge questions were recorded from 1 to 5 on a five point Likert scale 1 representing ‘Not at all important’ and 5 representing ‘Most important’. The interest on REKL questionnaire was designed to predict how much interest on REKL the participants have before using the lesson component of the BIM. A reliability test was conducted to test the internal consistency of the survey. The Cronbach's alpha, for

six-item interest on RE Knowledge questions, was found to be 0.82, which suggested good internal consistency. The survey was administered online on student voice.Appendix C contains the questionnaire items of student interest on RE KL.

The ten item student absorption of RE Knowledge questions were recorded from 1 to 5 on a five point Likert scale 1 representing ‘strongly disagree’ and 5 representing ‘strongly agree’. The absorption of REKL questionnaire was designed to predict how much REKL has been gathered and applied by the participants after using the BIM. A reliability test was conducted to test the internal consistency of the survey. The Cronbach's alpha, for ten-item absorption of RE Knowledge questions, was found to be 0.14, which suggested weak consistency. The survey was administered online on student voice. Appendix C contains the questionnaire items of student absorption of RE KL.

There are thirteen item module usability questions were recorded from 1 to 5 on a five point Likert scale 1 representing ‘strongly disagree’ and 5 representing ‘strongly agree’ (See Table 13). The module usability questionnaire was designed to predict the usefulness of BIM site. A reliability test was conducted to test the internal consistency of the survey. The Cronbach's alpha, for thirteen-item module usability questions, was found to be 0.91, which suggested strong internal consistency. The survey was administered online on student voice platform. Appendix C contains the questionnaire items of student usability and satisfaction on the module.

Table 13: Usability Questionnaire

Usability Questionnaire	Adapted From
Instructions to use the module were clear.	(Hegarty, 2005)
I found it easy to navigate around the module.	(Teoh & Neo, 2017)
The module is easy to launch	(Zaharias & Poylymenakou, 2009)
The fonts, colors, and sizes are consistent throughout the module	
The module maintains an appropriate level of consistency in its design from one part/section of the module to another.	
I found the interface clear, structured and appealing.	(Teoh & Neo, 2017)
Text and graphics are legible.	(Zaharias & Poylymenakou, 2009)
Fonts (style, color, saturation) are easy to read.	
The module does not provide too many long sections of text to read without meaningful interactions	
The module engaged me in interactive tasks that are closely aligned with the learning goals and objectives	
The module used interactive activities to gain the attention, sustain the interest, and maintain my motivation.	
Questions in the module enhanced my understanding of Requirements Elicitation process, ideas and concepts.	
The module provides guidance and support to complete individual sections including learning activities	

There are four-item satisfaction questions were recorded from 1 to 5 on a five point Likert scale 1 representing ‘strongly disagree’ and 5 representing ‘strongly agree’ (See Table 14). The satisfaction questionnaire was designed to predict how much the participants are satisfied using the BIM. A reliability test was conducted to test the internal consistency of the survey. The Cronbach's alpha, for four-item satisfaction questions, was found to be 0.88, which suggested strong internal consistency. The survey was administered online on a student voice platform.

Table 14: Satisfaction Questionnaire

Usability Questionnaire	Adapted From
I was able to complete the module quickly	(Lewis, 1995)
I was able to effectively complete the module	(Zaharias & Poylymenakou, 2009)
It was simple to use the module	(Lewis, 1995)

We used both the usability and the satisfaction constructs only in this study to check whether our BIM site is usable, useful and readable. The number of items we checked for the usability can be found under Usability questionnaire in Appendix C. We also tested how the students reacted, felt about our BIM site from the questionnaires setup for the satisfaction construct. Based on their feedback, we made the necessary changes to out BIM site. The number of items we used for the satisfaction construct can be found under Satisfaction questionnaire in Appendix C.

At this point, we did not measure the three soft skills. So, no reliability test has been done for the three soft skills constructs. After we completed our pilot study, we changed our BIM design according to the issues we faced in this study. We are now going to discuss the three studies we conducted, the changed design for the experiment and their respective results in the next section.

5.4 Study I Spring 2016

We conducted our experiment as an online assignment in three AIT600 classes during spring 2016 semester. The assignment was given to the class for a certain amount of time. Students need to complete the assignment within that due date. The assignment covers various activities of the module. The design of our behavioral injection module (BIM), the data analysis along with its results are discussed in the following sections.

5.4.1 Experimental Design of Online Module

We divided the participants of AIT600 classes into two groups: control and experimental. We had two AIT600 sections as control group with 28 participants and one AIT600 section as experimental group with 7 participants. We removed incomplete cases from data analysis. The BIM presented in the form of a website to both groups. We used Blackboard, an online learning tool, to run the module as an online assignment. The assignment has four steps to complete with required links and necessary instructions. The first step was to take the pre survey. The second step was to read the lesson topics. The module site contains lesson plan about requirement elicitation process and prompting techniques. The third step was to practice the question techniques. The practice session contains the dialog system to do the role-play simulation of the client and analyst for the requirement elicitation tasks. The dialog system provides a structured autocomplete questioning system of a sample case. Based on the questioning guideline learned from the module website, the experimental group prepared the interview questions with the responses. For the experimental group, we called this practiced set of questions with responses, Transcript. At this point both groups completed the pre surveys and the reading tasks. After reading the lesson plan, the experimental group exposed to the practice session to practice the question techniques. At the same time, the control group received the similar sample case to read. The control group in this semester were instructed not to prepare any transcripts. Both groups generated a report using the report template. The experimental group used their transcripts to prepare the report whereas the control group used the same case to prepare the report. Later, both groups conveyed their experiences on this module exercise through post-surveys. Participants from both groups completed all the steps in

order they were presented. The whole assignment was given for a week to complete. Table 15 displays summary of our experimental design for both groups. Our next section discusses about the data analysis and its source for AIT600 class.

Table 15: Experimental Design and Measurement Variables for Spring 2016

Items	**Activities for Groups (Spring 2016 Online)**			**Measurement Variables**	**Supporting Hypothesis**
	Experimental Group	**Control Group**	**Time Limit**		
Pre-Survey	Take Online Survey. Link available in the Blackboard.	Take Online Survey. Link available in the Blackboard.	1 day	Knowledge based Skills: Demographics, RE Knowledge(KL) and Awareness on REKL	H2a & H2b
Pedagogical Intervention (online test)	Step 1: Read the lesson topics from the Module website	Step 1: Read the lesson topics from the Module website	5 days	-	-
	Step 2: Use practice session link to prepare the transcript. Once done, save transcripts in the Blackboard.	Step 2: Use the attached Case to read. They did not prepare any transcripts.		Learning Performance:	H3a
	Step 3: Use the Report Template and Transcript to prepare the Report.	Step 3: Use the Report Template and the given case to prepare the Report.		Learning Performance:	H3b
Post-Survey	Take Online Survey. Link available in the Blackboard.	Take Online Survey. Link available in the Blackboard.	1 day	Knowledge based Skills: RE Knowledge , Awareness on REKL Soft Skills: Communication Skills, Perceptual Skills and Thinking Skills	H2a, H2b, H1a, H1b & H1c

Based on the feedback we received from the pilot study, we made few necessary changes to our design for the Spring 2016 studies. Some of the constructs that we have used for the pilot study have not been used in this study due to time limit for each class. The constructs that we did not use for this study are: Interest in RE, usability and satisfaction. We removed these constructs from both pre and post survey so that the students can complete the surveys within the class hour. We also added/deleted few more

items for the following constructs: Demographic, REKL and Absorption of REKL. The changes of the questionnaires for Spring 2016 can be found in Appendix C. The following section discusses about the reliability test conducted over all the measuring constructs including the three soft skills and their respective results.

5.4.2 Reliability Test

We have developed questionnaires for each measuring constructs: REKL, Awareness on REKL, Absorption of REKL and three Skills. Since we made few changes to the questionnaires, we need to rerun the reliability test. To determine the degree to which all the items are measuring the same construct, we chose Cronbach's alpha. Cronbach's alpha is one of many tests of reliability. Before a questionnaire can be valid, it must be reliable. Cronbach's alpha is a measure of internal consistency. We took average of the items for each participants and compute the total scores of all the items for each participants. Then we ran the reliability tests for all the constructs and shown the results in Table 16.

Table 16: Reliability Test of Spring 2016 Constructs

	Inter-Item Correlation	**Reliability Test**			
Measuring Constructs	**Pearson Correlation**	**# of Participants**	**# of Items**	**Cronbach's Alpha**	**Comment**
RE Knowledge	strong correlation exists	35	5	0.95	very high reliability
Awareness on REKL	weak correlation exists	35	6	0.58	low reliability
Communication Skills	strong correlation exists	35	6	0.70	high reliability
Information Skills	medium to strong correlation exists	35	9	0.64	high reliability
Thinking Skills	weak correlation exists	35	5	0.40	low reliability

5.4.3 Data Analysis

In this section, we explain both parametric test and non-parametric test we chose to do our data analysis. We used IBM SPSS Statistics 24 tool to do our data analysis. An assessment of the normality of data is a prerequisite for many statistical tests. There are two normality tests: the Shapiro-Wilk Test of Normality and the Kolmogorov-Smirnov Normality test. We ran the Shapiro-Wilk Test of Normality to determine whether our sample data drawn from a normally distributed population or not. We chose the Shapiro-Wilk test as our numerical means of assessing normality and reported the results accordingly for all the measuring constructs. The Shapiro-Wilk test is used only when the dataset (n) is smaller than 2000 samples otherwise the Kolmogorov-Smirnov test is used. In our case, we have 35 participants for AIT600.

The results of the Normality checks for class AIT600 shown in Table 17. We will look at the Shapiro Wilk Test (Sig. value) column of Table 17 to figure out whether our AIT600 class data is normally distributed or not. Our results are stated in terms of their level of significance. By looking at the Sig. value column, we determine whether the p value is significant at 0.05 level or not. If the p value is above 0.05, then the data is normal. We then choose either of the parametric tests: independent t test or paired sample t test. If the p value is below 0.05, then the data is not normal. When the data is not normal, we chose either the Mann-Whitney U (MWU) test or Wilcoxon test, which are the nonparametric equivalent of the independent *t* test and the paired-samples *t* test respectively. MWU tests whether or not two independent samples are from the same distribution. And the Wilcoxon tests whether or not two related samples are from the same

distribution. We reported which test we have used depending on the outcome of the Normality test.

Table 17: Normality Tests for all Measuring Constructs of AIT600 class

Testing Hypothesis	**Measuring Variables (Spring 2016)**	**Shapiro Wilk Test (Sig. value)**	**Normality Test -Result**	**Test Type {Non-Parametric (NP) / Parametric(P)}**
Hypothesis 1	Communication	.54	P>.05 Normally distributed	P: Independent t-test
	Perceptual	.33	P>.05 Normally distributed	P: Independent t-test
	Thinking	.57	P>.05 Normally distributed	P: Independent t-test
Hypothesis 2	Difference Scores for RE Knowledge	.03	P<.05 Not normally distributed	NP: Wilcoxon signed rank test
	Difference Scores for Awareness on RE KL	.03	P<.05 Not normally distributed	NP: Wilcoxon signed rank test
Hypothesis 3	RE Performance (Reports)	.00	P<.05 Not normally distributed	NP: Mann Whitney U-test

The data source for each construct for AIT600 class is listed in Table 18.

Table 18: Data Source for AIT600 Class (Spring 2016)

Measuring Variables (Spring 2016)	**Data Source for Analysis**	**Comment**
Communication	Post survey	Calculated means
Perceptual	Post survey	Calculated means
Thinking	Post survey	Calculated means
RE Knowledge	Pre & Post survey	Calculated means
Awareness on RE KL	Pre & Post survey	Calculated total scores
RE Performance	Report	Grades-Graded based on Criteria (Refer to Instruments section)

We had 6 items for communication skills construct, 9 items for perceptual skill construct and 5 items for thinking skill construct. We took the mean of the items of each of the above constructs. Then we compared the means of communication skills (H1a), perceptual skills (H1b) and thinking skills (H1c) between control group and experimental group. Similarly, we had 5 items for REKL and took the mean of the items for REKL construct. The Awareness on RE knowledge contains six questions and the data have been collected from both pre and post survey. We took the total correct scores for the Awareness on REKL. We then compared the means of Pre & Post REKL (H2a) and the scores of the Pre & Post Awareness on REKL (H2b) within control group and experimental group. We took the Pre and Post mean difference scores for both REKL and Awareness on REKL to run the normality check. We now discuss the results of AIT600 class data in the next section.

5.4.4 Results

The research study examined the effectiveness of the Behavioral Injection Module on students' RE Knowledge, Awareness on REKL, Communication Skills, Perceptual skills, Information Skills, and the learning performance. We have summarized our results for AIT600 class data in Table 19. We put forth the hypotheses and then discuss the corresponding results in this section.

Table 19: Summary Result of AIT600 Online Data Analysis

AIT600, 2016 Online Data Constructs	**Normality Test - Shapiro Wilk Test**	**Test Type (Non Parametric/Parametric)**	**Results (final)**	**Hypothesis Status**
Communication	P>.05 Normally distributed	P: Independent t-test	Non-Significant (p>.05)	Hypothesis[3] 1 not supported
Perceptual	P>.05 Normally distributed	P: Independent t-test	Non-Significant (p>.05)	
Thinking	P>.05 Normally distributed	P: Independent t-test	Non-Significant (p>.05)	
REKL	P<.05 Not normally distributed	NP: Wilcoxon signed rank test	Non-Significant (p>.05)	Hypothesis 2 not supported
AWR in REKL	P<.05 Not normally distributed	NP: Wilcoxon signed rank test	Non-Significant (p>.05)	
RE Performance (Report)	P<.05 Not normally distributed	NP: Mann Whitney U-test	Non-Significant (p<.05)	Hypothesis 3 not supported

5.4.4.1 Hypothesis 1

H1: Critical Soft skills demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-paly simulation.

H1a: Individuals participating in the role-play simulation will have better communication skills than those not participating in the role-play simulation.

We used the Independent samples t-test to compare the Communication mean score of the control group who did not receive the practice session to the Communication mean score of the experimental group who received the practice session. We chose this parametric test as the data was normal.

[3] When using SPSS, we normally reject null hypothesis if the output values under Sig.is equal to or smaller than .05, and we fail to reject the null hypothesis if the output value is larger than .05.

The output of the Independent t-test is labelled as “Independent Samples Test” (Table 20). From Table 20, no significance difference was found {t (33) = 0.54; p>.05)}. This implies that the students who participated in the role-play simulation did not increase any communication skills than the students who did not participate. Thus, H1a hypothesis not supported.

Table 20: Independent sample t- Test Results for Communication mean

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Communication Mean	Equal variances assumed[4]	2.72	.11	.54	33	.53	.15	.23	-.42	.73

H1b: Individuals participating in the role-play simulation will have better perceptual skills than those not participating in the role-play simulation.

We used the Independent samples t-test to compare the perceptual mean score of the control group who did not receive the practice session to the perceptual mean score of the experimental group who received the practice session. We chose this parametric test as the data was normal.

[4] Refer to Table 20: If the “Sig.” for “Levene’s Test for Equality of Variances” is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported

From Table 21, no significant difference was found {t (19.7) = .35; p>.05)}. This implies that the students who participated in the role-play simulation did not have better perceptual skills than the students who did not. Thus, H1b hypothesis not supported.

Table 21: Independent sample t- Test Results for Perceptual mean

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Perceptual Mean	Equal variances not assumed[5]			.35	19.71	.73	.07	.20	-.35	.50

H1c: Individuals participating in the role-play simulation will have better thinking skills than those not participating in the role-play simulation.

We used the Independent samples t-test to compare the thinking mean score of the control group who did not receive the practice session to the thinking mean score of the experimental group who received the practice session. We chose this parametric test as the data was normal.

[5]Refer to Table 21: If the "Sig." for "Levene's Test for Equality of Variances" is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported otherwise we report the second row which is "Equal variances not assumed" (Holcomb, Z. 2014). Here we have reported "Equal variances not assumed" row.

From Table 22, no significance difference was found {t (33) =1.82; p>.05)}. This implies that the students who participated in the role-play simulation did not have better thinking skills than the students who did not. Thus, H1c hypothesis not supported.

Table 22: Independent sample t-test Results for Thinking mean

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Thinking Mean	Equal variances assumed[6]	3.663	.064	-1.818	33	.078	-.53571	.29460	-1.13508	.06365

5.4.4.2 Hypothesis 2

H2: Individuals will demonstrate higher levels of knowledge based skills after interacting with the Behavioral Injection Module.

H2a: Individuals will demonstrate higher levels of RE knowledge after interacting with the Behavioral Injection Module.

We ran Wilcoxon ranked test to determine whether there is a median difference in REKL between paired observations. In order to use the Wilcoxon signed-rank test to determine if there is a statistically significant median difference between two related groups, we have shown a histogram chart in Figure 4 to show the shape of the distribution

[6] Refer to Table 22: If the "Sig." for "Levene's Test for Equality of Variances" is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported otherwise we report the second row which is "Equal variances not assumed" (Holcomb, Z. 2014). Here we have reported "Equal variances assumed" row.

of the differences to be symmetrical. By visually inspecting the shape of the distribution of difference scores, we can see that the scores do appear to be approximately symmetrical and thus we can use the Wilcoxon signed-rank test to analyze our data.

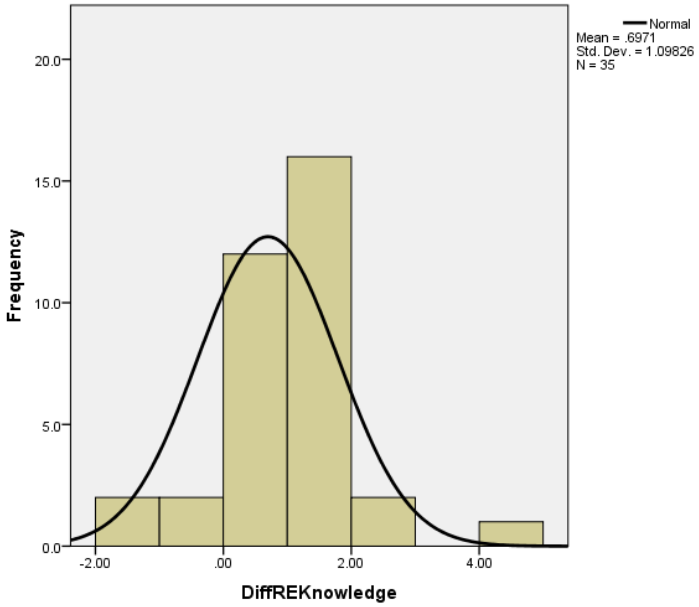

Figure 4: Histogram to show the symmetrical shape of the distribution of Differences in REKL Scores.

From Table 23 we see how many participants in both groups had improved their REKL after reading the module content, how many remained the same, and how many had worse performance.

Table 23: Ranks Table of RE Knowledge for both groups

Ranks					
Control vs Experimental			N	Mean Rank	Sum of Ranks
Control	Post REKnowledge - Pre REKnowledge	Negative Ranks	2[a]	12.25	24.50
		Positive Ranks	15[b]	8.57	128.50
		Ties	11[c]		
		Total	28		
Experimental	Post REKnowledge - Pre REKnowledge	Negative Ranks	2[a]	2.50	5.00
		Positive Ranks	5[b]	4.60	23.00
		Ties	0[c]		
		Total	7		
a. Post REKnowledge < Pre REKnowledge					
b. Post REKnowledge > Pre REKnowledge					
c. Post REKnowledge = Pre REKnowledge					

Table 23 shows for control group, 15 out of 28 participants had "positive ranks" which means 15 participants did well in post REKL task than the pre REKL task. That is15 participants who received the module has increased knowledge on RE. There were 11 participants (e.g. the eleven “Ties”) who did not increase any REKL even after being exposed to the module.

For the experimental group, 5 out of 7 participants had "positive ranks" which means 5 participants did well in post REKL task than the pre REKL task. That is 15 participants who received the module have increased REKL. There were no such participants (e.g. the zero “Ties”) who did not increase REKL even after being exposed to the module.

A Wilcoxon signed-rank test[7] determined that there was statistically significant median increase in REKL (1.0) by comparing the Pre REKL scores (4.) to the Post REKL scores (5.0), (z = -3.11, p = .002) (Refer to Table 24 & Table 25).

Table 24: Test Statistics for REKL

Test Statistics[a]		
Control vs Experimental		Post REKnowledge - Pre REKnowledge
Control	Z	-2.482[b]
	Asymp. Sig. (2-tailed)	.013
Experimental	Z	-1.527[b]
	Asymp. Sig. (2-tailed)	.127
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		

Table 25: Median Report for REKL

Report		
Median		
Pre REKnowledge	Post REKnowledge	DiffREKnowledge
4.0000	5.0000	1.0000

This implies that the students in experimental groups did increase RE knowledge but the control group also increased knowledge in RE, after reading the module content. Thus, H2b hypothesis supported.

[7] The "**Asymp. Sig. (2-tailed)**" row in the Test Statistics table contains the statistical significance of the Wilcoxon signed-rank test (i.e., the p-value). The Wilcoxon signed-rank test is a test of whether the median difference between the related groups is 0 (zero) *in the population*. If the p-value is less than .05 (i.e., $p < .05$), you have a statistically significant result (i.e., the median difference is statistically significantly different from 0). If $p > .05$, you do not have a statistically significant result and there is no median difference between the related groups in the population (i.e., the median difference is not statistically significant different from 0).

H2b: Individuals will demonstrate higher level of Awareness on RE knowledge after interacting with the Behavioral Injection Module.

We ran Wilcoxon ranked test to determine whether there is a median difference in Awareness of REKL between paired observations. In order to use the Wilcoxon signed-rank test to determine if there is a statistically significant median difference between two related groups, we have shown a histogram chart in Figure 5 to show the shape of the distribution of the differences to be symmetrical. By visually inspecting the shape of the distribution of difference scores, we can see that the scores do appear to be approximately symmetrical and thus we can use the Wilcoxon signed-rank test to analyze our data.

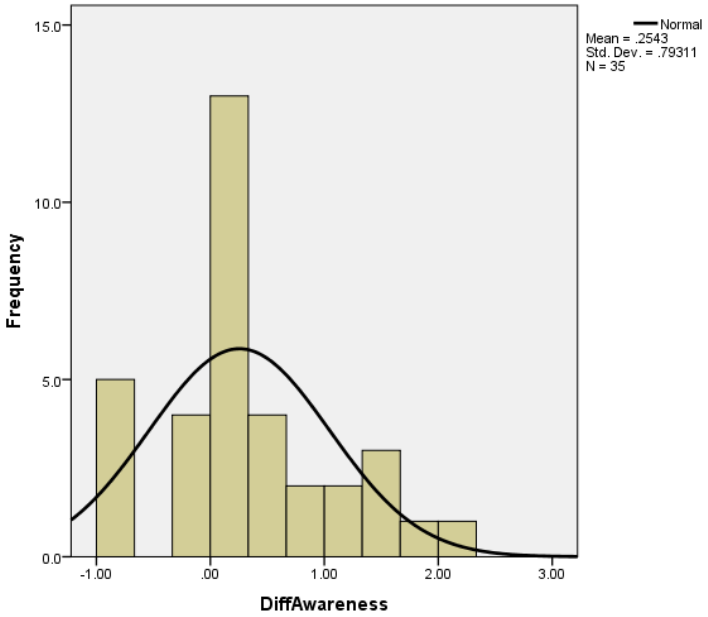

Figure 5: Histogram to show the symmetrical shape of the distribution of Differences in Awareness on REKL Scores

From Table 26 we see how many participants had improved their awareness on REKL after reading the module content, how many remained the same, and how many had worse performance. The table shows that 15 out of 35 participants had "positive ranks" which means 15 participants in both groups did well in post awareness task than the pre

awareness task. That is the participants who received the module has increased awareness on REKL. There were 11 participants (e.g. the eleven "Ties") who did not increase any awareness on REKL even after being exposed to the module.

Table 26: Ranks Table for Awareness on RE Knowledge

Ranks					
Control vs Experimental			N	Mean Rank	Sum of Ranks
Control	Post Awareness Scores - Pre Awareness Score	Negative Ranks	9[a]	9.83	88.50
		Positive Ranks	15[b]	14.10	211.50
		Ties	4[c]		
		Total	28		
Experimental	Post Awareness Scores - Pre Awareness Score	Negative Ranks	2[a]	2.00	4.00
		Positive Ranks	1[b]	2.00	2.00
		Ties	4[c]		
		Total	7		
a. Post Awareness Scores < Pre Awareness Score					
b. Post Awareness Scores > Pre Awareness Score					
c. Post Awareness Scores = Pre Awareness Score					

A Wilcoxon signed-rank test determined that there was no statistically significant median increase in Awareness on REKL (0.2) by comparing the Pre Awareness on REKL scores (3.80) to the Post Awareness on REKL scores (4.00), (z = -1.76, p=0.08) (refer to Table 27 and Table 28).

Table 27: Median Report for Awareness on RE Knowledge

Report		
Median		
Pre Awareness	Post Awareness	DiffScoreAWR
3.8000	4.0000	.2000

Table 28: Test Statistics for Awareness on RE Knowledge

Test Statistics[a]		
Control vs Experimental		Post Awareness - Pre Awareness
Control	Z	-1.76[b]
	Asymp. Sig. (2-tailed)	.08
Experimental	Z	-.58[c]
	Asymp. Sig. (2-tailed)	.56
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		
c. Based on positive ranks.		

This implies that the students in both groups did not increase awareness on RE knowledge even after reading the module content. Thus, H2b hypothesis not supported.

5.4.4.3 Hypothesis 3

H3: Task competency demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-play simulation

H3a: Individuals participating in the role-play simulation will generate better quality reports than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in Report quality between experimental and control groups. Distributions of the report scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 6).

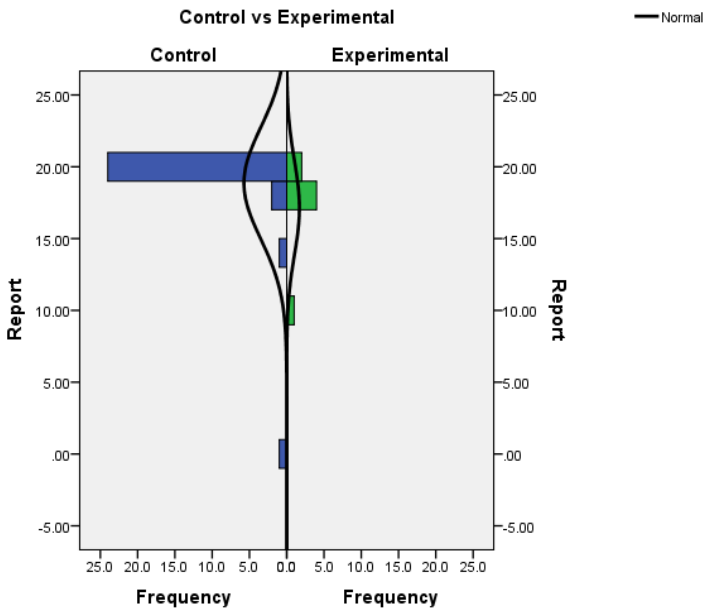

Figure 6: Population Pyramid for Report Scores

From Table 29, we can see there is significant difference in report scores between experimental and control, $U = 34.00$, $p < .05$, using an exact sampling distribution for U (Dineen & Blakesley, 1973). In other words, we can say that the students who were not exposed to the practice session did better in report writing than those who did expose to. Thus, H3a hypothesis is not supported.

Table 29: Mann-Whitney U-test for Report

Test Statistics	
	Report
Mann-Whitney U	34.00
Wilcoxon W	62.00
Z	-3.12
Asymp. Sig. (2-tailed)	.00
Exact Sig. [2*(1-tailed Sig.)]	.01[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

We have summarized all the Mean and Median for all the constructs shown in Table 30. From the table, we can see that the experimental group has higher means and medians compare to Control group for all the constructs.

Table 30: Mean and Median Table for Study I

	Experimental						Control					
Outcome	Pre Mean	SD	Median	Post Mean	SD	Median	Pre Mean	SD	Median	Post Mean	SD	Median
Communication				3.77	.46	3.70				3.62	.71	3.75
Perceptual				3.63	.38	3.70				3.56	.76	3.60
Thinking				3.23	.33	3.20				3.76	.75	3.80
REKL	2.48	.72	2.60	3.20	.59	3.00	4.30	1.70	5.00	4.99	1.22	5.60
AWR on REKL	5.43	.79	6.00	5.29	1.11	6.00	3.48	1.49	3.00	3.80	1.18	3.70
Transcript	-	-	-	-	-	-	-	-	-	-	-	-
Report				17.14	3.29	18.00				18.86	3.89	20.00

5.5 Study II Summer 2016

We conducted our experiment as an online assignment in two COSC111 classes during summer 2016 semester. The assignment was given online for a certain amount of time. Students need to complete the assignment within that due date. We prepared our module activities in such that the participants can complete the assignment in due time. The design of our behavioral injection module (BIM), the data analysis along with its results are discussed in the following sections.

5.5.1 Experimental Design of Online Module

We divided the participants of COSC111 classes into two groups: control and experimental. We had one section of COSC111 as control with 4 participants and one section as experimental group with 24 participants. We did not count the ones who did not complete the module assignment at all in the data analysis. The BIM presented in the form of a website to both groups. We used the Blackboard, an online learning tool, to run the module as an online assignment. The assignment has four steps to complete with required

links and necessary instructions. The first step was to take the pre survey. The second step was to read the lesson topics. The module site contains lesson plan about requirement elicitation process and prompting techniques. The third step was to practice the question techniques. The practice session contains the dialog system to do the role-play simulation of the client and analyst for the requirement elicitation tasks. The dialog system provides a structured autocomplete questioning system of a sample case. Based on the questioning guideline learned from the module website, the experimental group prepared the interview questions with the responses. For the experimental group, we called this practiced set of questions, Transcript. At this point both groups completed the pre surveys and the reading tasks. After reading the lesson plan, the experimental group exposed to the practice session to practice the question techniques. At the same time, the control group received the similar sample case to read. The control group in this semester were instructed not to prepare any transcripts. Both groups generated a report using the report template. The experimental group used their transcripts to prepare the report whereas the control group used the same case to prepare the report. Later, both groups conveyed their experiences on this module exercise through post-surveys. Participants from both groups completed all the steps in order they were presented. The whole assignment was given for a week to complete. Table 31 displays summary of our experimental design for both groups.

We used the same surveys and did not make any changes to the design after the study I. We used the same measuring constructs as we did for Study I except we removed the Absorption of REKL construct as the survey was getting too long and repetitive. We also did not instruct the participants to prepare the transcript in this study. Our next section discusses about the data analysis and its source for COSC111 class.

Table 31: Experimental Design and Measurement Variables for Summer 2016

Items	Activities for Groups (Summer 2016 Online)			Measurement Variables	Supporting Hypothesis
	Experimental Group	Control Group	Time Limit		
Pre-Survey	Take Online Survey. Link available in the Blackboard.	Take Online Survey. Link available in the Blackboard.	1 day	Knowledge based Skills: Demographics, RE Knowledge(KL) and Awareness on REKL	H2a & H2b
Pedagogical Intervention (online test)	Step 1: Read the lesson topics from the Module website	Step 1: Read the lesson topics from the Module website	5 days		-
	Step 2: Use practice session link to prepare the transcript. Once done, save transcripts in the Blackboard.	Step 2: Use the attached Case to read. They did not prepare any transcripts.		Learning Performance	H3a
	Step 3: Use the Report Template and Transcript to prepare the Report.	Step 3: Use the Report Template and the given case to prepare the Report.		Learning Performance	H3b
Post-Survey	Take Online Survey. Link available in the Blackboard.	Take Online Survey. Link available in the Blackboard.	1 day	Knowledge based Skills: RE Knowledge , Awareness on REKL Soft Skills: Communication Skills, Perceptual Skills and Thinking Skills	H2a, H2b, H1a, H1b & H1c

5.5.2 Data Analysis

In Study II, we have 28 samples. The results of the Normality checks for class COSC111 shown in Table 32. We will look at the Shapiro Wilk Test (Sig. value) column of Table 32 to figure out whether our COSC111 class data is normally distributed or not. Our results are stated in terms of their level of significance.

Table 32: Normality Tests for all Measuring Constructs of COSC111

Testing Hypothesis	**Measuring Variables (COSC111, 2016 online)**	**Shapiro Wilk Test (Sig. value)**	**Normality Test -Result**	**Test Type {Non-Parametric (NP) / Parametric(P)}**
Hypothesis 1	Communication	.00	P<.05 Not Normally distributed	NP: Mann Whitney U-test
	Perceptual	.03	P<.05 Not Normally distributed	NP: Mann Whitney U-test
	Thinking	.00	P<.05 Not Normally distributed	NP: Mann Whitney U-test
Hypothesis 2	Difference Scores for RE Knowledge	.03	P<.05 Not normally distributed	NP: Wilcoxon signed rank test
	Difference Scores for Awareness on RE KL	.01	P<.05 Not normally distributed	NP: Wilcoxon signed rank test
Hypothesis 3	RE Performance (Reports)	.00	P<.05 Not normally distributed	NP: Mann Whitney U-test

We reported which test we have used depending on the outcome of the Normality test. The data source for each construct for COSC111 class is listed in Table 33.

Table 33: Data Source for COSC111 Class (Summer 2016)

Measuring Variables (Spring 2016)	**Data Source for Analysis**	**Comment**
Communication	Post survey	Calculated means
Perceptual	Post survey	Calculated means
Thinking	Post survey	Calculated means
RE Knowledge	Pre & Post survey	Calculated means
Awareness on RE KL	Pre & Post survey	Calculated total scores
RE Performance	Report	Grades-Graded based on Criteria (Refer to Instruments section)

We had 6 items for communication skills construct, 9 items for perceptual skill construct and 5 items for thinking skill construct. We took the mean of the items of each of the above constructs. Then we compared the means of communication skills (H1a), perceptual skills (H1b) and thinking skills (H1c) between control group and experimental group. Similarly, we had 5 items for REKL and took the mean of the items for REKL construct. The Awareness on RE knowledge contains six questions and the data have been collected from both Pre and post survey. We took the total correct scores for the Awareness on REKL. We then compared the means of Pre & Post REKL (H2a) and the scores of the Pre & Post Awareness on REKL (H2b) within control group and experimental group. We took the Pre and Post mean difference scores for both REKL and Awareness on REKL to run the normality check. We now discuss the results of COSC111 class data in the next section.

5.5.3 Results

The research study examined the effectiveness of the Behavioral Injection Module on students' RE Knowledge, Awareness on REKL, Communication Skills, Perceptual skills, Information Skills, and the learning performance. We have summarized our results of COSC111 data in Table 34. We put forth the hypotheses and then discusses the corresponding results in this section.

Table 34: Summary Result of COSC111 Online Data Analysis

Summer 2016 Constructs	**Normality Test -Shapiro Wilk Test**	**Test Type (Non Parametric/Parametric)**	**Results (final)**	**Hypothesis Status**
Communication	P<.05 Not Normally distributed	NP: Mann Whitney U-test	Non-Significant (p>.05)	Hypothesis 1 not supported
Perceptual	P<.05 Not Normally distributed	NP: Mann Whitney U-test	Non-Significant (p>.05)	
Thinking	P<.05 Not Normally distributed	NP: Mann Whitney U-test	Non-Significant (p>.05)	
Diff in REKL	P<.05 Not normally distributed	NP: Wilcoxon signed rank test	Significant (p<.05)	Hypothesis 2 not supported
Diff in AWR on REKL	P<.05 Not normally distributed	NP: Wilcoxon signed rank test	Non-Significant (p>.05)	
RE Performance (Report)	P<.05 Not normally distributed	NP: Mann Whitney U-test	Non-Significant (p>.05)	Hypothesis 3 not supported

5.5.3.1 Hypothesis 1

H1: Critical Soft skills demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-paly simulation.

H1a: Individuals participating in the role-play simulation will have better communication skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in communication score between experimental and control groups. Distributions of the communication scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 7).

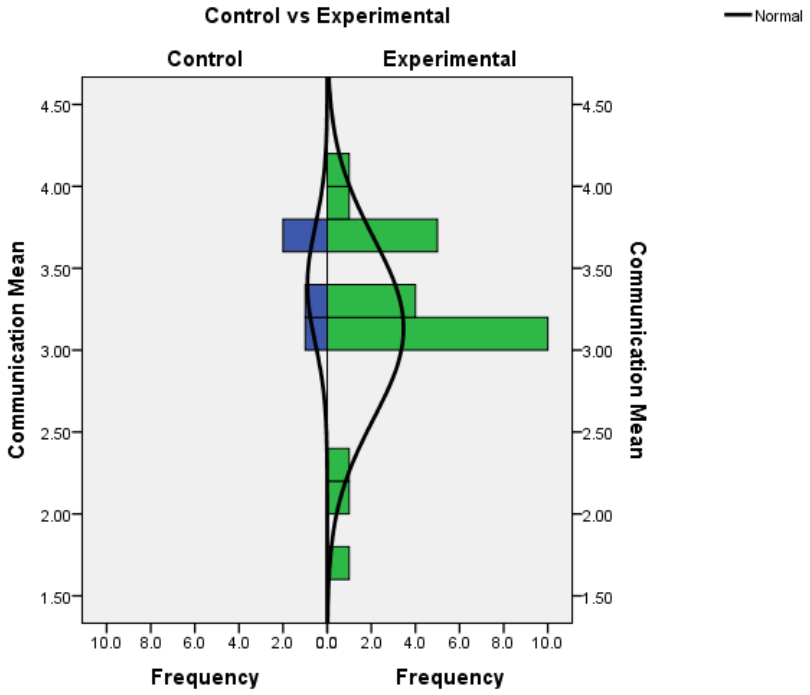

Figure 7: Population Pyramid for Communication score of both Groups

From Table 35, we can see there was no statistically significant difference in communication scores between experimental and control, U = 34.50, z= -.92, p = .39, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

That is to say that the individuals participating in the role-play simulation did not have better communication skills than those not participating in the role-play simulation. Thus, H1a hypothesis not supported.

Table 35: Mann-Whitney U Test of Communication Score

Test Statistics	
	Communication
Mann-Whitney U[8]	34.50
Wilcoxon W	334.50
Z	-.92
Asymp. Sig. (2-tailed)	.36
Exact Sig. [2*(1-tailed Sig.)]	.39[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

H1b: Individuals participating in the role-play simulation will have better perceptual skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in perceptual score between experimental and control groups. Distributions of the perceptual scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 8).

[8] Consult the **Test Statistics** Table 35 that shows the Mann-Whitney U value given at the intersection of the row labeled Mann-Whitney U and the column labeled with the dependent variable. There are two p values given - one on the row labeled Asymp. Sig (2-Tailed) and the other on the row labeled Exact Sig. [2*(1- tailed Sig.)]. Here, we reported the exact significance as our sample size <20. If the sample size is large, the asymptotic significance value can be used. To determine if there is any significance between the two groups, we look at the exact p value. If the p<.05, we accept our hypothesis; if the p>.05 we reject our hypothesis.

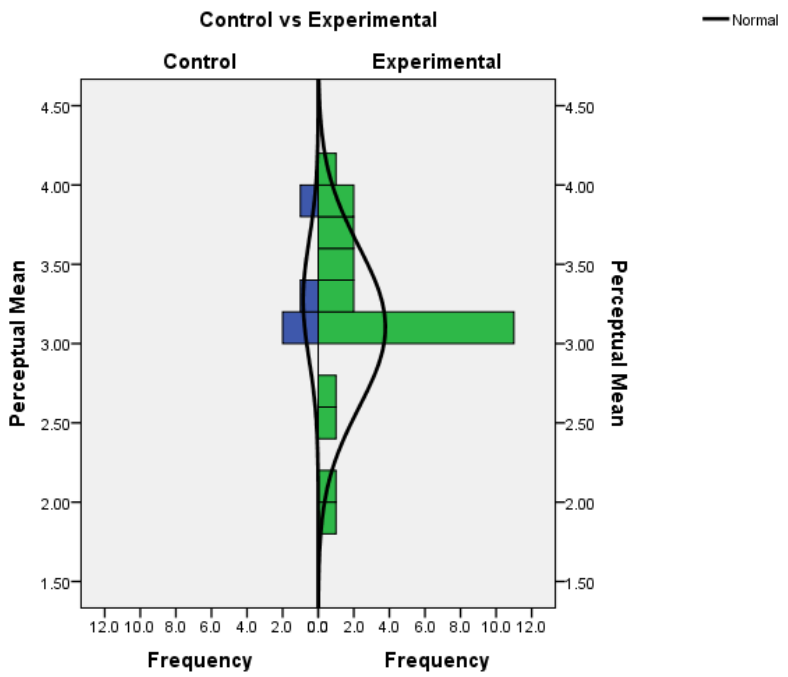

Figure 8: Population Pyramid for Perceptual score of both Groups

From Table 36, we can see there was no statistically significant difference in perceptual scores between experimental and control, U = 41.00, z=--.475, p = .681, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

Table 36: Mann-Whitney U Test of Perceptual Score for both groups

Test Statistics	
	Perceptual
Mann-Whitney U	41.00
Wilcoxon W	341.00
Z	-.47
Asymp. Sig. (2-tailed)	.63
Exact Sig. [2*(1-tailed Sig.)]	.68[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

That is to say that the individuals participating in the role-play simulation did not have better perceptual skills than those not participating in the role-play simulation. Thus, H1b hypothesis not supported.

H1c: Individuals participating in the role-play simulation will have better thinking skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in thinking score between experimental and control groups. Distributions of the thinking scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 9).

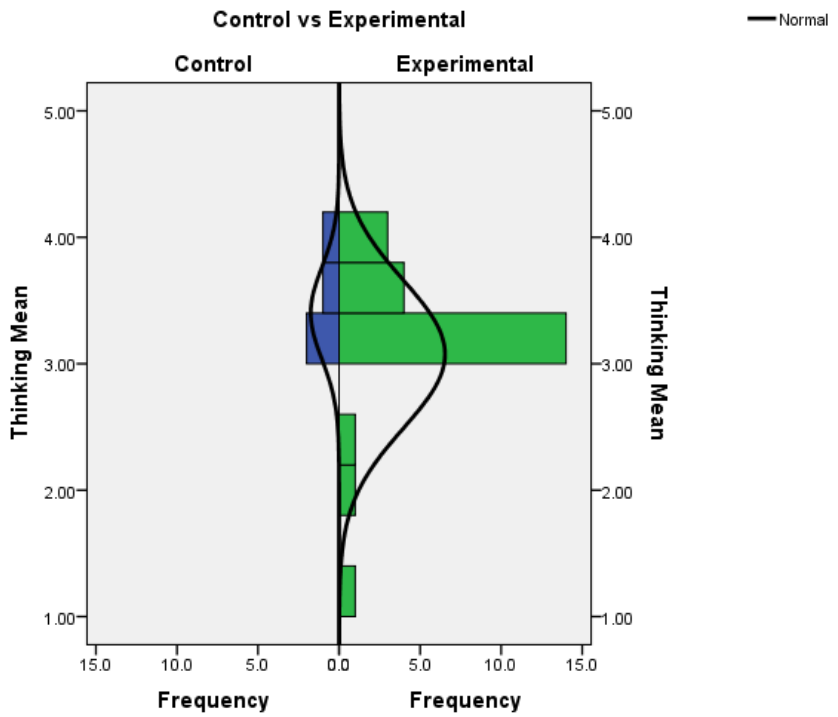

Figure 9: Population Pyramid for Thinking score of both Groups

From Table 37, we can see there was no statistically significant difference in thinking scores between experimental and control, U = 30.00, z=-1.23, p =.26, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

That is to say that the individuals participating in the role-play simulation did not have better thinking skills than those not participating in the role-play simulation. Thus, H1c hypothesis not supported.

Table 37: Mann-Whitney U Test of Thinking Score for both groups

Test Statistics	
	Thinking
Mann-Whitney U	30.00
Wilcoxon W	330.00
Z	-1.23
Asymp. Sig. (2-tailed)	.22
Exact Sig. [2*(1-tailed Sig.)]	.26[b]
a. Grouping Variable: Control vs Experimental	

5.5.3.2 Hypothesis 2

H2: Individuals will demonstrate higher levels of knowledge based skills after interacting with the Behavioral Injection Module.

H2a: Individuals will demonstrate higher levels of RE knowledge after interacting with the Behavioral Injection Module.

We ran Wilcoxon ranked test to determine whether there is a median difference in REKL between paired observations. In order to use the Wilcoxon signed-rank test to determine if there is a statistically significant median difference between two related groups, we have shown a histogram chart in Figure 10 to show the shape of the distribution of the differences to be symmetrical. By visually inspecting the shape of the distribution of difference scores, we can see that the scores do appear to be approximately symmetrical and thus we can use the Wilcoxon signed-rank test to analyze our data.

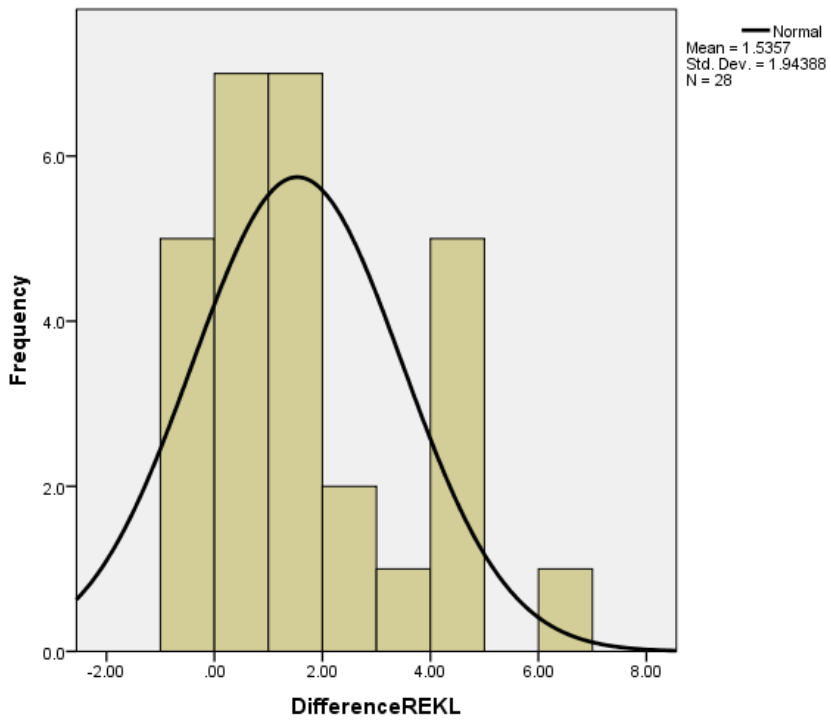

Figure 10: Histogram to show the symmetrical shape of the distribution of Differences in REKL Scores.

From Table 38 we see how many participants in both groups had improved their REKL after reading the module content, how many remained the same, and how many had worse performance. Table 38 shows for control group, 4 out of 4 participants had "positive ranks" which means all the participants did well in post REKL than the pre REKL. That is the participants who received the module has increased REKL. There were no participants (e.g. the zero “Ties”) who did not increase any REKL even after being exposed to the module.

Table 38: Ranks Table of RE Knowledge for both groups

Ranks					
Control vs Experimental			N	Mean Rank	Sum of Ranks
Control	Post REKnowledge - Pre REKnowledge	Negative Ranks	0[a]	.00	.00
		Positive Ranks	4[b]	2.50	10.00
		Ties	0[c]		
		Total	4		
Experimental	Post REKnowledge Mean - Pre REKnowledge Mean	Negative Ranks	5[a]	7.00	35.00
		Positive Ranks	17[b]	12.82	218.00
		Ties	2[c]		
		Total	24		
a. Post REKnowledge Mean < Pre REKnowledge Mean					
b. Post REKnowledge Mean > Pre REKnowledge Mean					
c. Post REKnowledge Mean = Pre REKnowledge Mean					

For the experimental group, 17 out of 24 participants had "positive ranks" which means 17 participants did well in post REKL than the pre REKL. That is 17 participants who received the module has increased awareness on REKL. There were 2 participants (e.g. the two “Ties”) who did not increase any awareness on REKL even after being exposed to the module.

A Wilcoxon signed-rank test determined that there was a significance difference found in the results (z= -3.57, $p<.05$) (refer to Table 39). This implies that the students in both groups increased RE knowledge after reading the module content. This leads us to accept H2b hypothesis.

Table 39: Test Statistics for RE Knowledge

Test Statistics[a]		
Control vs Experimental		Post REKnowledge - Pre REKnowledge
Control	Z	-1.83[b]
	Asymp. Sig. (2-tailed)	.07
Experimental	Z	-2.98[b]
	Asymp. Sig. (2-tailed)	.00
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		

H2b: Individuals will demonstrate higher levels of Awareness on RE knowledge after interacting with the Behavioral Injection Module.

We ran Wilcoxon ranked test to determine whether there is a median difference in Awareness of REKL between paired observations. In order to use the Wilcoxon signed-rank test to determine if there is a statistically significant median difference between two related groups, we have shown a histogram chart in Figure 11 to show the shape of the distribution of the differences to be symmetrical. By visually inspecting the shape of the distribution of difference scores, we can see that the scores do appear to be approximately symmetrical and thus we can use the Wilcoxon signed-rank test to analyze our data.

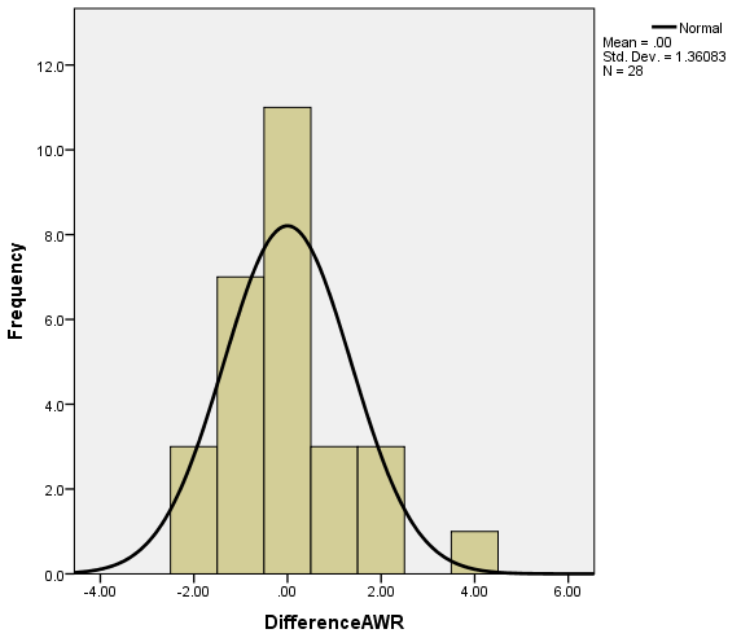

Figure 11: Histogram to show the symmetrical shape of the distribution of Differences in Awareness Scores.

From Table 40 we see how many participants in both groups had improved their awareness in REKL after reading the module content, how many remained the same, and how many had worse performance. Table 40 shows for control group, 1 out of 4 participants had "positive ranks" which means 1 participant did well in post awareness task than the pre awareness task. That is the participants who received the module has increased awareness on REKL. There were 3 participants (e.g. the three “Ties”) who did not increase any awareness on REKL even after being exposed to the module.

Table 40: Ranks Table for Awareness on RE Knowledge for both groups

Ranks					
Control vs Experimental			N	Mean Rank	Sum of Ranks
Control	Post Awareness Scores - Pre Awareness Score	Negative Ranks	0[a]	.00	.00
		Positive Ranks	1[b]	1.00	1.00
		Ties	3[c]		
		Total	4		
Experimental	Post Awareness Scores - Pre Awareness Score	Negative Ranks	10[a]	7.25	72.50
		Positive Ranks	6[b]	10.58	63.50
		Ties	8[c]		
		Total	24		
a. Post AWRness Scores < Pre Awareness Score					
b. Post AWRness Scores > Pre Awareness Score					
c. Post AWRness Scores = Pre Awareness Score					

For the experimental group, 6 out of 24 participants had "positive ranks" which means only 6 participants did well in post awareness task than the pre awareness task. That is 6 participants who received the module has increased awareness on REKL. There were 8 participants (e.g. the eight “Ties”) who did not increase any awareness on REKL even after being exposed to the module. This is to note that 10 participants out 24 already had some previous RE knowledge. There was no effect on them even after they have exposed to the BIM activity.

A Wilcoxon signed-rank test determined that there was no significance difference found in the results ($z = -.122$, $p > .05$) (Refer to Table 41). This implies that the students in both groups did not increase awareness on RE knowledge after reading the module content. Thus, H2b hypothesis not supported based on the tests results.

Table 41: Test Statistics for Awareness on RE Knowledge

Test Statistics[a]		
Control vs Experimental		Post Awareness Scores - Pre Awareness Score
Control	Z	-1.00[b]
	Asymp. Sig. (2-tailed)	.32
Experimental	Z	-.24[c]
	Asymp. Sig. (2-tailed)	.81
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		
c. Based on positive ranks.		

5.5.3.3 Hypothesis 3

H3: Task competency demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-play simulation.

H3a: Individuals participating in the role-play simulation will generate better quality reports than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in Report quality between experimental and control groups. Distributions of the report grade scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 12).

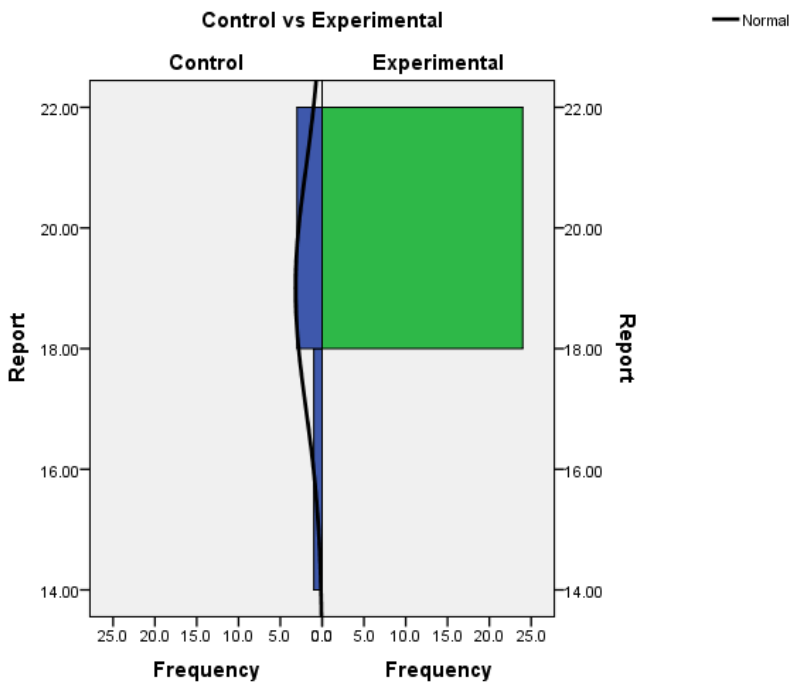

Figure 12: Population Pyramid for Report score of both Control and Experimental Groups

From Table 42, we can see there is no statistically significant difference in report scores between experimental and control, $U = 36.00$, $z = -2.45$, $p = .46$, using an exact sampling distribution for U (Dineen & Blakesley, 1973). That is to say that the individuals participating in the role-play simulation did not generate better quality reports compare to those who did not participate in the role-play simulation. Thus, H3a hypothesis not supported.

Table 42: Mann-Whitney U-test for Report

Test Statistics	
	Report
Mann-Whitney U	36.00
Wilcoxon W	46.00
Z	-2.45
Asymp. Sig. (2-tailed)	.01
Exact Sig. [2*(1-tailed Sig.)]	.46[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

We have summarized all the Mean and Median for all the constructs shown in Table 43. From the table, we can see that the experimental group has higher means and medians compare to Control group for all the constructs.

Table 43: Mean and Median Table for Study II

	Experimental						Control					
Outcome	Pre Mean	SD	Median	Post Mean	SD	Median	Pre Mean	SD	Median	Post Mean	SD	Median
Communication				3.13	.55	3.00				3.40	.35	3.45
Perceptual				3.10	.51	3.00				3.27	.38	3.15
Thinking				3.07	.59	3.00				3.40	.36	3.40
REKL	2.05	1.03	2.00	3.02	1.02	3.00	1.90	.77	1.70	6.85	1.15	6.70
AWR on REKL	3.96	1.46	4.00	3.92	1.47	4.00	4.50	1.29	4.5	4.75	.96	4.5
Transcript	-	-	-	-	-	-	-	-	-	-	-	-
Report				20.00	.00	20.00				19.00	2.00	20.00

5.6 Study III Spring 2017 In-class

We conducted our experiment as an in-class assignment in both CIS440 & CIS475 courses during spring 2017 semester. The duration of the class for both courses was 1 hour and 15 minutes. We prepared our module activities in such that the participants can complete the assignment in class time. The design of our behavioral injection module (BIM), the data analysis along with its results are discussed in the following sections.

5.6.1 Experimental Design of In-Class Module

We chose CIS440 class as our control group and CIS475 class as our experimental group. There were 10 participants in CIS440 class. In CIS475 there were total 18 participants. We did not count the ones who did not complete the module assignment at all in the data analysis. The BIM was presented in the form of a website to both groups. The BIM site contains a lesson plan and practice session. The lesson plan contains topics about requirement elicitation process and prompting techniques. The practice session contains the dialog system to do the role-play simulation of the client and analyst for the requirement elicitation tasks. In the first step of the assignment, participants in both groups took an online pre-survey before coming to the class. This pre-survey measures how much knowledge participants have about ISD and RE process. After the survey, both groups receive the same BIM lesson plan. In the lesson plan, there was a short quiz to reinforce the concepts for both groups. The participants took the quiz after the completion of reading the topics. The questions for the Quiz were similar to Awareness on RE KL questions. Until this step, both groups conducted the same tasks. The experimental group was then exposed to the practice session of the BIM to practice the question techniques. The practice session provides the group to do role-play simulation task of a sample case. The role-play simulation task contains a dialog system, which provides a structured autocomplete questioning system of a sample case. The participants practiced a set of questions along with the responses. We called this practiced set of questions with responses, Transcript for the experimental group. At the same time, the control group received the similar sample case to prepare a set of interview questions. Here the control group did not get the role-play simulation task of the BIM. The control group rather received the paper based sample

case in the class. They were then instructed to prepare the transcripts and to take notes simultaneously from the given case study. The control group used the notes later to prepare the report template. Once both groups finished preparing the transcripts, they generated a report based on their transcripts.

After that, they handed over the completed report to the instructor. Later, both groups conveyed their experiences on this module assignment through post-surveys. The post-survey helped us to determine the learning performance and soft skills development after the role-play experiment. Table 44 displays the summary of our experimental design for both groups. The next section talks about the data analysis and its source.

Table 44: Spring 2017 In-Class Experimental Design and Measurement Variables

Items	**Activities for Groups (Spring 2017 In-Class)**			**Measurement Variables**	**Supporting Hypothesis**
	Experimental Group (CIS475)	**Control Group (CIS440)**	**Time Limit**		
Pre-Survey	Take Home: Pre Survey. Link available in the Blackboard. Need to complete before coming to class.	Take Home: Pre Survey. Link available in the Blackboard. Need to complete before coming to class.	5-8 mins	Knowledge based Skills: Demographics, RE Knowledge (KL) and Awareness on RE KL	H2a & H2b
Pedagogical Intervention (in-class tasks)	Step 1: Read the lesson topics from Module Website	Step 1: Read the lesson topics from Module Website	20 mins.		-
	Step 2: Take Quiz	Step 2: Take Quiz	5 mins	Awareness on RE KL	H2b
	Step 3: Practice interview questions with dialogue system	Step 3: Practice interview questions on their own using paper-based sample case	20 mins	Learning Performance	H3a
	Step 4: Generate requirement specifications report using transcripts	Step 4: Generate requirement specifications report using notes	30 mins	Learning Performance	H3b
Post-Survey	Take home: Post Survey. Link is available in the Blackboard.	Take home: Post Survey. Link is available in the Blackboard.	Same day by mid-night	Knowledge based Skills: RE Knowledge (KL) Soft Skills: Communication, Perceptual & Thinking Skills	H2a, H1a, H1b & H1c

5.6.2 Reliability Test

We have revised our questionnaires for each measuring constructs: Awareness on REKL and three Skills. Since we made few changes to the questionnaires, we need to rerun the reliability test. To be reliable, the questionnaire must be valid. A valid questionnaire measures what we intended to measure. We have conducted the Reliability Test for the constructs shown in Table 45.

Table 45: Reliability Test of Spring 2016 Constructs

	Inter-Item Correlation	**Reliability Test**			
Measuring Constructs	**Pearson Correlation**	**# of Participants**	**# of Items**	**Cronbach's Alpha**	**Comment**
RE Knowledge	strong correlation exists	28	5	0.926	very high reliability
Awareness on REKL	weak correlation exists	28	5	0.229	low reliability
Communication Skills	medium to strong correlation exists	28	5	0.825	high reliability
Information Skills	medium to strong correlation exists	28	7	0.874	high reliability
Thinking Skills	medium correlation exists	28	4	0.838	high reliability

5.6.3 Data Analysis

In this study, we have 28 samples. We look at the Shapiro Wilk Test (Sig. value) column of Table 46 to figure out whether our data is normally distributed or not. Our results are stated in terms of their level of significance.

Table 46: Normality Tests for all Measuring Constructs

Testing Hypothesis	**Measuring Variables (Spring 2017 In-class)**	**Shapiro Wilk Test (Sig. value)**	**Normality Test -Result**	**Non-Parametric (NP) / Parametric(P) test**
Hypothesis 1	Communication	.04	P<.05 Not normally distributed	NP: Mann Whitney U-test
	Perceptual	.04	P<.05 Not normally distributed	NP: Mann Whitney U-test
	Thinking	.16	P>.05 Normally distributed	P: Independent t-test
Hypothesis 2	Difference Scores for RE Knowledge	.69	P>.05 Normally distributed	P: Paired Sample t-test
	Difference Scores for Awareness on RE KL	.00	P<.05 Not normally distributed	NP: Wilcoxon signed rank test
Hypothesis 3	RE Performance (transcript)	.13	P>.05 Normally distributed	P: Independent t-test
	RE Performance (report)	.01	P<.05 Not normally distributed	NP: Mann Whitney U-test

We reported which test we have used depending on the outcome of the Normality test. The data source for each construct listed in Table 47.

Table 47: Data Source for Analysis

Measuring Variables (Spring 2017 In-class)	**Data Source for Analysis**	**Comment**
Communication	Post survey	Calculated means
Perceptual	Post survey	Calculated means
Thinking	Post survey	Calculated means
RE Knowledge	Pre & Post survey	Calculated means
Awareness on RE KL	Pre & Post survey	Calculated total scores
RE Performance	Transcript	Grades-Graded based on Criteria (Refer to Instruments section)
RE Performance	Report	Grades-Graded based on Criteria (Refer to Instruments section)

We compared the means of communication skills (H1a), perceptual skills (H1b) and thinking skills (H1c) between control group and experimental group. We compared the means of Pre & Post REKL (H2a) and Pre & Post Awareness on REKL (H2b) within control group and experimental group. We took the Pre and Post mean difference scores for the normality check. If the data were normally distributed, we tested our hypothesis H2a & H2b using Paired Sample t-test. Otherwise, we opted for Wilcoxon test, a non-parametric test. The Awareness of RE knowledge scores have been collected from both Pre survey and Quiz.

From both the study I and II, we found that the surveys were still very long and some of the items were redundant. So we made the necessary changes to the survey questionnaires in our next study III. We also found the topic were still very unclear to the participants and so made the necessary changes to both the topics and the instructions for

the next study III and IV. The changes to the new surveys are available under Appendix C. We discuss the results in the next section.

5.6.4 Results

The research study examined the effectiveness of the BIM on students' RE Knowledge, Awareness on REKL, learning performance and the three soft skills: Communication Skills, Perceptual skills, Thinking Skills. We have summarized our results in Table 48. We put forth the hypotheses and then discusses the corresponding results in this section.

Table 48: Summary Result of Spring 2017 In-class Data Analysis

Spring 2017 in-class Data Constructs	**Normality Test - Shapiro Wilk Test**	**(Non-Parametric /Parametric)**	**Results (final)**	
Communication	P<.05 Not normally distributed	NP: Mann Whitney U-test	Non-Significant (p>.05)	Hypothesis 1[9] not support
Perceptual	P<.05 Not normally distributed	NP: Mann Whitney U-test	Non-Significant (p>.05)	
Thinking	P>.05 Normally distributed	P: Independent t-test	Non-Significant (p>.05)	
REKL	P>.05 Normally distributed	P: Paired Sample t-test	Significant (p<.05)	Hypothesis 2 Supported
AWR in REKL	P<.05 Not normally distributed	NP: Wilcoxon test	Significant (p<.05)	
RE Performance (transcript)	P>.05 Normally distributed	P: Independent t-test	Significant (p<.05)	Hypothesis 3 Supported
RE Performance (report)	P<.05 Not normally distributed	NP: Mann Whitney U-test	Significant (p<.05)	

[9] When using SPSS, we normally support alternative hypothesis if the p value is significant at .05 level and we do not support the alternative hypothesis if the p value is not significant at .05 level.

5.6.4.1 Hypothesis 1

H1: Critical Soft skills demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-paly simulation.

H1a: Individuals participating in the role-play simulation will have better communication skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in communication score between experimental and control groups. Distributions of the communication scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 13).

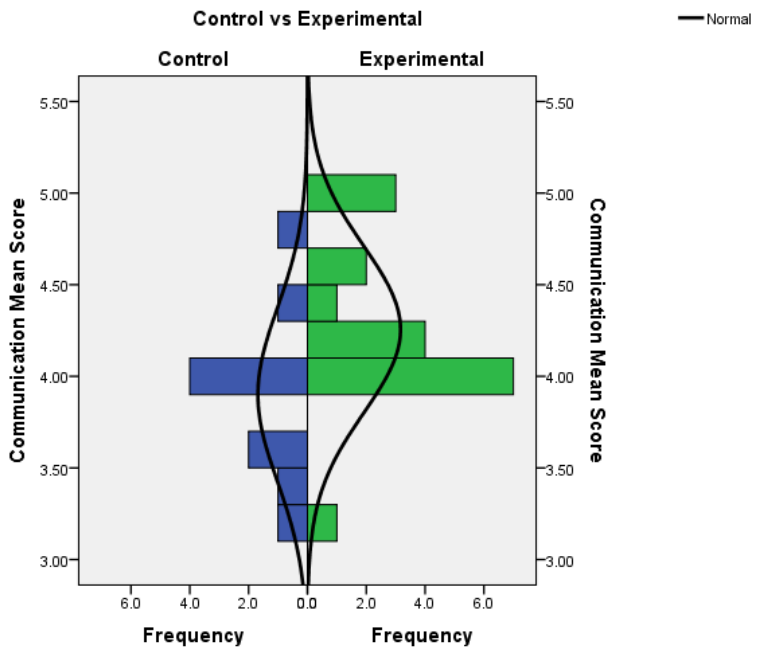

Figure 13: Population Pyramid for Communication score of both Groups

From Table 49, we can see there was no statistically significant difference in communication scores between experimental and control, U = 49.00, z= -2.03, p = .051, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

Individuals participating in the role-play simulation did not have better communication skills than those not participating in the role-play simulation. Thus, H1a hypothesis not supported.

Table 49: Mann-Whitney U Test of Communication scores for both groups

Test Statistics[a]	
	Communication Score
Mann-Whitney U	49.00
Wilcoxon W	104.00
Z	-2.03
Asymp. Sig. (2-tailed)	.04
Exact Sig. [2*(1-tailed Sig.)]	.05[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

H1b: Individuals participating in the role-play simulation will have better perceptual skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in perceptual score between experimental and control groups. Distributions of the perceptual scores for experimental and control were not similar, as assessed by visual inspection (refer to Figure 14).

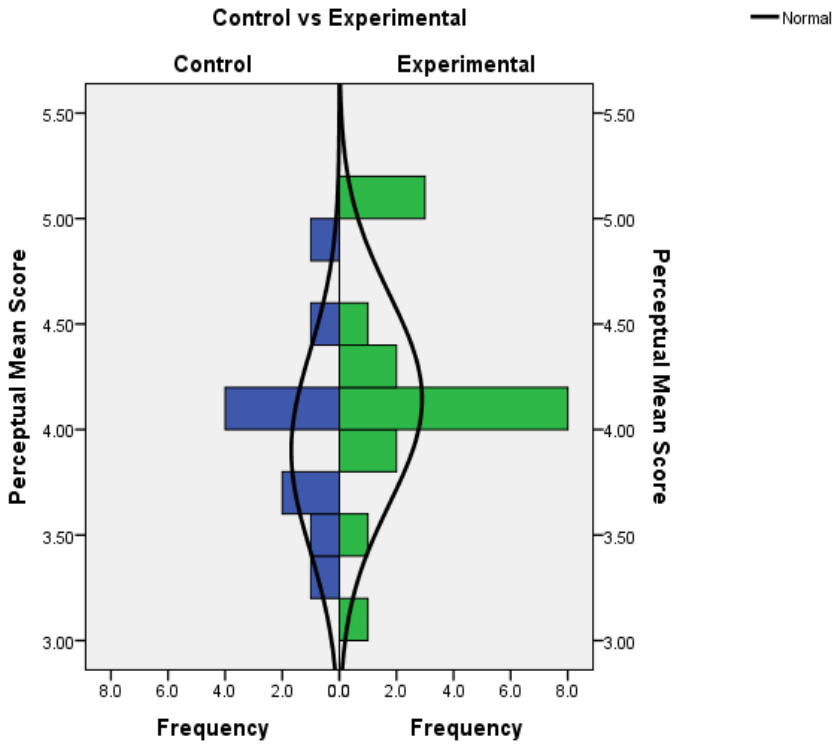

Figure 14: Population Pyramid for Perceptual score of both Groups

From Table 50, we can see there was no statistically significant difference in perceptual scores between experimental and control, U = 62.00, z=-1.37, p = .19, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

Table 50: Mann-Whitney U Test of Perceptual score for both groups

Test Statistics	
	Perceptual
Mann-Whitney U	62.00
Wilcoxon W	117.00
Z	-1.37
Asymp. Sig. (2-tailed)	.17
Exact Sig. [2*(1-tailed Sig.)]	.19[b]

Individuals participating in the role-play simulation did not have better perceptual skills than those not participating in the role-play simulation. Thus, H1b hypothesis not supported.

H1c: Individuals participating in the role-play simulation will have better thinking skills than those not participating in the role-play simulation.

An Independent t-test was calculated comparing the thinking score of the participants who did role-play simulation to the thinking score of the participants who did not. No significant difference was found (t (26) =.93, p >.05) (refer to Table 51).

Table 51: Independent t-test of Thinking scores for both groups

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Thinking Mean	Equal variances assumed[10]	.02	.88	.93	26	.36	.21	.23	-.25	.68

This implies that the participants who exposed to the role-play simulation task did not have better thinking skills than that of those who were exposed to the role-play simulation task. Thus, H1c hypothesis not supported.

[10] Refer to Table 51: If the “Sig.” for “Levene’s Test for Equality of Variances” is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported (Holcomb, Z. 2014). Here we have reported “Equal variances assumed” row.

5.6.4.2 Hypothesis 2

H2: Individuals will demonstrate higher levels of knowledge based skills after interacting with the Behavioral Injection Module.

H2a: Individuals will demonstrate higher levels of RE knowledge after interacting with the Behavioral Injection Module.

A Paired sample t-test was run to see if there is any significant difference in RE KL within two groups. From Table 52, we can see that there is a significant difference in the scores for pre RE Knowledge scores (m= 2.4, sd= 0.80) and post RE Knowledge scores (m= 3.64, sd= 0.86); t (9) =6.51, p<0.001 for control group. Similarly for the experimental group, there is a significant difference in the scores for RE Knowledge scores before using the module (m= 2.23, sd= 0.58) and RE Knowledge scores after using the module (m= 4.14, sd= 0.54); {t (17)=10.62, p < 0.001} (Refer to Table 52 & 58).

Table 52: Paired samples Test of RE Knowledge for both groups

Paired Samples Test										
			Paired Differences							
Control vs Experimental			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Control	Pair 1	Post REKnowledge - Pre REKnowledge	1.24	.60	.19	.81	1.67	6.51	9	.00
Experimental	Pair 1	Post REKnowledge - Pre REKnowledge	1.85	.74	.17	1.49	2.22	10.62	17	.00

Specifically, our results suggest that students of both groups exposed to Behavioral Injection Module did gain some knowledge on RE. This leads us to accept H2a hypothesis.

H2b: Individuals will demonstrate higher levels of Awareness on RE knowledge after interacting with the Behavioral Injection Module.

We ran Wilcoxon ranked test[11] to determine whether there is a median difference in Awareness on REKL between paired observations. In order to use the Wilcoxon signed-rank test to determine if there is a statistically significant median difference between two related groups, we have shown a histogram chart in Figure 15 to show the shape of the distribution of the differences to be symmetrical. By visually inspecting the shape of the distribution of difference scores, we can see that the scores do appear to be approximately symmetrical and thus we can use the Wilcoxon signed-rank test to analyze our data.

[11] The "**Asymp. Sig. (2-tailed)**" row in the Test Statistics table contains the statistical significance of the Wilcoxon signed-rank test (i.e., the *p*-value). The Wilcoxon signed-rank test is a test of whether the median difference between the related groups is 0 (zero) *in the population*. If the *p*-value is less than .05 (i.e., $p < .05$), you have a statistically significant result (i.e., the median difference is statistically significantly different from 0). If $p > .05$, you do not have a statistically significant result and there is no median difference between the related groups in the population (i.e., the median difference is not statistically significant different from 0).

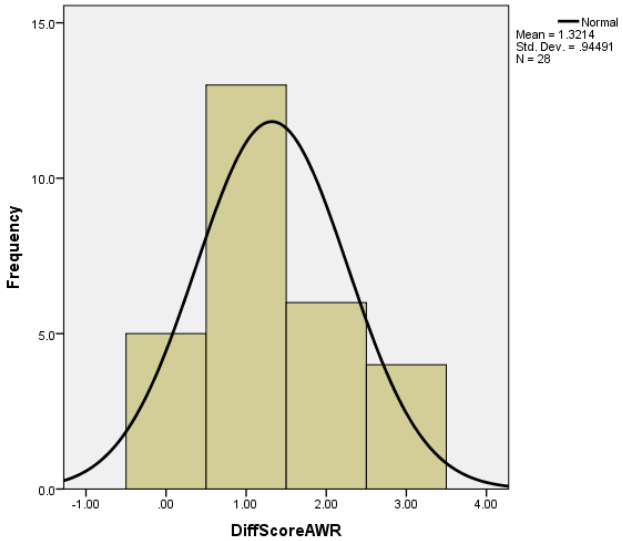

Figure 15: Histogram to show the symmetrical shape of the distribution of Differences in Awareness Scores.

From Table 63 we see how many participants in both groups had improved their awareness in REKL after reading the module content, how many remained the same, and how many had worse performance. Table 53 shows for control group, 8 out of 10 participants had "positive ranks" which means 8 participants did well in post awareness task than the pre awareness task. That is the participants who received the module has increased awareness on REKL. There were 2 participants (e.g. the two “Ties”) who did not increase any awareness on REKL even after being exposed to the module.

Table 53: Ranks Table for Awareness on RE Knowledge for both groups

Ranks					
Control vs Experimental			N	Mean Rank	Sum of Ranks
Control	Post Awareness Score - Pre Awareness Score	Negative Ranks	0[a]	.00	.00
		Positive Ranks	8[b]	4.50	36.00
		Ties	2[c]		
		Total	10		
Experimental	Post Awareness Score - Pre Awareness Score	Negative Ranks	0[a]	.00	.00
		Positive Ranks	15[b]	8.00	120.00
		Ties	3[c]		
		Total	18		
a. Post Awareness Score < Pre Awareness Score					
b. Post Awareness Score > Pre Awareness Score					
c. Post Awareness Score = Pre Awareness Score					

For the experimental group, 15 out of 18 participants had "positive ranks" which means 15 participants did well in post awareness task than the pre awareness task. That is the participants who received the module has increased awareness on REKL. There were 3 participants (e.g. the three “Ties”) who did not increase any awareness on REKL even after being exposed to the module.

A Wilcoxon signed-rank test determined that there was a statistically significant median increase for control group in Awareness on REKL (0.5) by comparing the Pre Awareness on REKL scores (3.5) to the Post Awareness on REKL scores (4.0), $z = -2.56$, $p < .05$ (Refer to Table 54 & 55).

Similarly, a Wilcoxon signed-rank test determined that there was a statistically significant median increase for experimental group in Awareness on REKL (1.0) by comparing the Pre Awareness on REKL scores (4.0) to the Post Awareness on REKL scores (5.0), $z = -3.50$, $p < .05$ (Refer to Table 54 & 55).

Table 54: Median Report for Awareness on RE Knowledge

Statistics				
Control vs Experimental			Pre Awareness	Post Awareness
Control	N	Valid	10	10
		Missing	0	0
	Median		3.5000	4.0000
Experimental	N	Valid	18	18
		Missing	0	0
	Median		4.0000	5.0000

Table 55: Test Statistics for Awareness on RE Knowledge

Test Statistics		
Control vs Experimental		Post Awareness Scores - Pre Awareness Score
Control	Z	-2.56[b]
	Asymp. Sig. (2-tailed)	.01
Experimental	Z	-3.50[b]
	Asymp. Sig. (2-tailed)	.00
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		

This implies that the students in both groups increased awareness on RE knowledge after reading the module content. This leads us to accept H2b hypothesis.

5.6.4.3 Hypothesis 3

H3: Task competency demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-play simulation

H3a: Individuals participating in the role-play simulation will generate better set of questions than those not participating in the role-play simulation.

An Independent t-test was run to compare the set of questions scores of the control group who did not receive the practice session to the transcript (refer to Appendix A) score of the experimental group who received the practice session.

From Table 56, we can see the difference between the two scores is statistically significant at the 0.05 level {t (14.71) = 2.45; p=.03}. This implies that the students who participated in the role-play simulation generated better set of questions than those who did not participate. Thus, we can accept H3a hypothesis.

Table 56: Independent sample t-test for Transcript Scores

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Transcript Scores	Equal variances not assumed[12]	7.19	.01	2.45	14.71	.03	5.53	2.26	.70	10.36

H3b: Individuals participating in the role-play simulation will generate better quality report than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in Report quality between experimental and control groups. Distributions of the report grade scores

[12] Refer to Table 56: If the "Sig." for "Levene's Test for Equality of Variances" is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported (Holcomb, Z. 2014). Here we have reported "Equal variances not assumed" row.

for experimental and control were not similar, as assessed by visual inspection (refer to Figure 16).

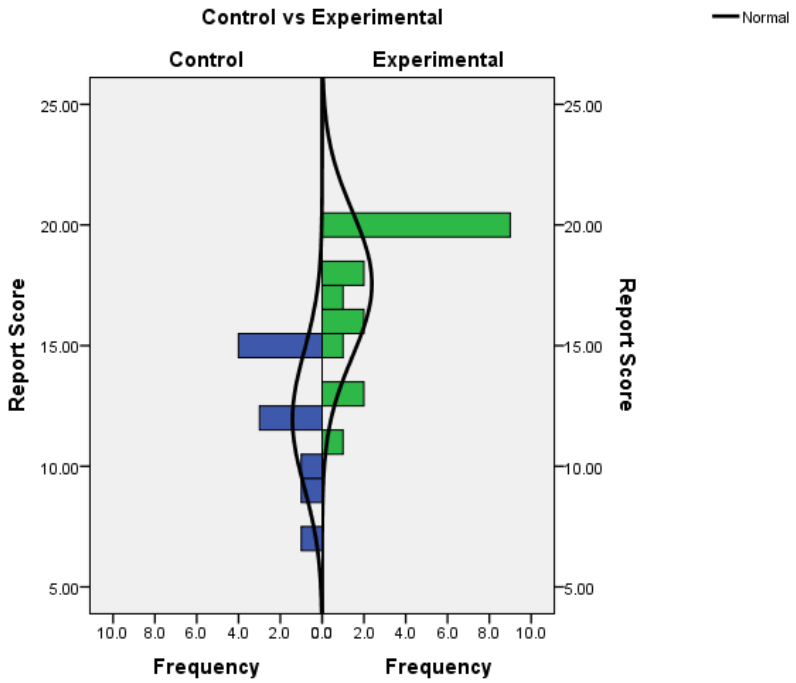

Figure 16: Population Pyramid for Report score of both Groups

From Table 57, we can see there is statistically significant difference in report scores between experimental and control, $U = 15.5$, $p < .05$, using an exact sampling distribution for U (Dineen & Blakesley, 1973). Individuals participating in the role-play simulation generated better quality report than those not participating in the role-play simulation. Thus, we accept H3b hypothesis.

Table 57: Mann-Whitney U-test for Report Scores

Test Statistics	
	Report Grades
Mann-Whitney U	15.50
Wilcoxon W	70.50
Z	-3.64
Asymp. Sig. (2-tailed)	.00
Exact Sig. [2*(1-tailed Sig.)]	.00[b]

We have summarized all the Mean and Median for all the constructs shown in Table 58. From the table, we can see that the experimental group has higher means and medians compare to Control group for all the constructs.

Table 58: Mean and Median Table for Study III

	Experimental						Control					
Outcome	Pre Mean	SD	Median	Post Mean	SD	Median	Pre Mean	SD	Median	Post Mean	SD	Median
Communication				4.25	.45	4.20				3.90	.47	4.00
Perceptual				4.14	.50	4.05				3.90	.47	4.00
Thinking				4.11	.55	4.00				3.90	.61	4.00
REKL	2.29	.58	2.30	4.14	.54	4.00	2.40	.80	2.60	3.64	.86	3.50
AWR on REKL	3.23	.96	4.00	4.55	.51	5.00	3.00	1.15	3.50	4.40	.52	4.00
Transcript				17.67	4.16	16.50				11.15	6.23	11.37
Report				17.55	3.02	19.00				11.95	2.81	12.00

5.7 Study IV Spring 2017 Online

We conducted our experiment as an online assignment in both AIT600 (2 sections) & AIT624 courses during spring 2017 semester. The assignment was given to the class for a certain amount of time. Students need to complete the assignment within that due date. For both courses, the students completed the assignment within a week deadline. We prepared our module activities in such that the participants can complete the assignment in

due time. The design of our behavioral injection module (BIM), the data analysis along with its results are discussed in the following sections.

5.7.1 Experimental Design of Online Module

We divided the participants of both AIT600 and AIT624 courses into two groups: control and experimental. There were 14 participants in experimental group and 13 participants in control group. We did not count the ones who did not complete the module assignment at all in the data analysis. The BIM presented in the form of a website to both groups. We used Blackboard, online learning tool to run the module as an online exercise. The links for both the module and the surveys were posted in the Blackboard along with the instructions. The module site contains lesson plan about requirement elicitation process and prompting techniques. It also contains a separate component: practice session. The practice session contains the dialog system to do the role-play simulation of the client and analyst for the requirement elicitation tasks. In the first step, participants on both groups took an online pre-survey followed by the module exercise. The module exercise contains the lesson section, quiz, practice session and the report template. Participants from both groups completed each activity in the module exercise in order they were presented. Once completed, the participants were not able to go back to the previous activity. The whole assignment was given for a week to complete. After reading the lesson plan, participants from both groups took a short quiz to reinforce the concepts. The quiz questions were similar to the Awareness of REKL construct questions. Once the quiz is taken, the experimental group exposed to the practice session to practice the question techniques. The practice session contains the dialog system to do the role-play simulation of the client and analyst requirement elicitation tasks. The dialog system provides a structured autocomplete

questioning system of a sample case. Based on the questioning guideline learned from the module website, the experimental group prepared the interview questions with the responses. For the experimental group, we called this practiced set of questions with responses, Transcript. At the same time, the control group received the similar sample case to prepare a set of interview questions. During this practice session, only the experimental group performed role-play experiment to simulate the task of analyst-user requirement elicitation process. Once they finished the role-play, they generated a report based on their interview questions responses using the report template. The control group also generated a report after reading the same case study. Later, both groups conveyed their experiences on this module exercise through post-surveys. The post-survey helped us to determine the learning performance and soft skills development after the role-play experiment. No changes have been done to this design after the study I. Table 59 displays summary of our experimental design for both groups. Our next section discusses about the data analysis and its source.

In this study we did not make any changes to the design, BIM lesson plan and the survey questionnaires.

Table 59: Experimental Design and Measurement Variables for Spring 2017 Online Classes

Items	Activities for Groups (Spring 2017 Online)			Measurement Variables	Supporting Hypothesis
	Experimental Group	**Control Group**	**Time Limit**		
Pre-Survey	Take Online Survey. Link available in the Blackboard.	Take Online Survey. Link available in the Blackboard.	1 day	Knowledge Based Skills: Demographics, RE Knowledge(KL) and Awareness on REKL	H2a & H2b
Pedagogical Intervention (online test)	Step 1: Read the lesson topics from the Module website	Step 1: Read the lesson topics from the Module website	5 days		-
	Step 2: Take Quiz	Step 2: Take Quiz		Awareness on RE KL	H2b
	Step 3: Use practice session link In Blackboard to prepare the transcript. Once done, save transcripts in the Blackboard.	Step 3: Use the attached Case to read, prepare and practice set of questions; take notes as much as possible. Once done, save questions in the Blackboard.		Learning Performance: RE Task Competency	H3a
	Step 4: Use the Report Template and Transcript to prepare the Report.	Step 4: Use the Report Template and the notes to prepare the Report.		Learning Performance: Requirements Quality	H3b
Post-Survey	Take Online Survey. Link available in the Blackboard.	Take Online Survey. Link available in the Blackboard.	1 day	Knowledge Based Skills: RE Knowledge Soft Skills: Communication Skills, Perceptual Skills and Thinking Skills	H2a, H1a, H1b & H1c

5.7.2 Data Analysis

In this section, we explain both parametric test and non-parametric test we chose to do our data analysis. In our case, we have 27 samples. The results of the Normality checks are shown in Table 60. We look at the Shapiro Wilk Test (Sig. value) column of Table 60 to figure out whether our data is normally distributed or not.

Table 60: Normality Tests for all Measuring Constructs (Spring 2017 Online)

Testing Hypothesis	**Measuring Variables (Spring 2017 Online)**	**Shapiro Wilk Test (Sig. value)**	**Normality Test - Result**	**Non-Parametric (NP) / Parametric (P) test**
Hypothesis 1	Communication	.002	P<.05 Not normally distributed	NP: Mann Whitney U-test
	Perceptual	.000	P<.05 Not normally distributed	NP: Mann Whitney U-test
	Thinking	.000	P<.05 Not normally distributed	NP: Mann Whitney U-test
Hypothesis 2	Difference Scores for RE Knowledge	.336	P>.05 Normally distributed	P: Paired sample t-test
	Difference Scores for Awareness on RE KL	.001	P<.05 Not normally distributed	NP: Wilcoxon signed rank test
Hypothesis 3	RE Performance (Transcript)	.054	P>.05 Normally distributed	P: Independent t-test
	RE Performance (Report)	.134	P>.05 Normally distributed	P: Independent t-test

We then choose the parametric tests: independent t test or paired sample t test. We reported which test we have used depending on the outcome of the Normality test.

The data source for each construct listed in Table 61. We compared the means of communication skills (H1a), perceptual skills (H1b) and thinking skills (H1c) between control group and experimental group. We compared the means of Pre & Post REKL (H2a) and Pre & Post Awareness on REKL (H2b) within control group and experimental group. We took the Pre and Post mean difference scores for the normality check. If the data were normally distributed, we tested our hypothesis H2a & H2b using Paired Sample t-test. Otherwise, we opted for Wilcoxon test, a non-parametric test. The Awareness of RE

knowledge scores have been collected from both Pre survey and Quiz. We now discuss the results in the next section.

Table 61: Data Source for Analysis

Measuring Variables (Spring 2017 Online)	**Data Source for Analysis**	**Comment**
Communication	Post survey	Calculated means
Perceptual	Post survey	Calculated means
Thinking	Post survey	Calculated means
RE Knowledge	Pre & Post survey	Calculated means
Awareness on RE KL	Pre & Post survey	Calculated total scores
RE Performance	Transcript	Grades-Graded based on Criteria (Refer to Instruments section)
RE Performance	Report	Grades-Graded based on Criteria (Refer to Instruments section)

5.7.3 Results

The research study examined the effectiveness of the BIM on students' RE Knowledge, Awareness on REKL, learning performance and the three soft skills: Communication Skills, Perceptual skills, Thinking Skills. We have summarized our results in Table 62. We put forth the hypotheses and then discusses the corresponding results in this section.

Table 62: Summary Result of Spring 2017 Online Data Analysis

Spring 2017 Online Data Constructs	**Normality Test -Shapiro Wilk Test**	**(Non-Parametric /Parametric)**	**Results (final)**	**Hypothesis Status**
Communication	Not normally distributed	Mann Whitney U-test	Non-Significant (p=.076)	Hypothesis 1not support
Perceptual	Not normally distributed	Mann Whitney U-test	Non-Significant (p=.685)	
Thinking	Not normally distributed	Mann Whitney U-test	Non-Significant (p=.325)	
REKL	Normally distributed	Paired sample t-test	Significant (p<.001)	Hypothesis 2 supported
AWR in REKL	Not normally distributed	Wilcoxon signed rank test	Significant (p<.05)	
RE Performance (Transcript)	Normally distributed	Independent t-test	Significant (p<.05)	Hypothesis 3 supported
RE Performance (Report)	Normally distributed	Independent t-test	Significant (p<.001)	

5.7.3.1 Hypothesis 1

H1: Critical Soft skills demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-play simulation.

H1a: Individuals participating in the role-play simulation will have better communication skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in communication score between experimental and control groups. Distributions of the communication scores for experimental and control were not similar, as assessed by visual inspection from Figure 17.

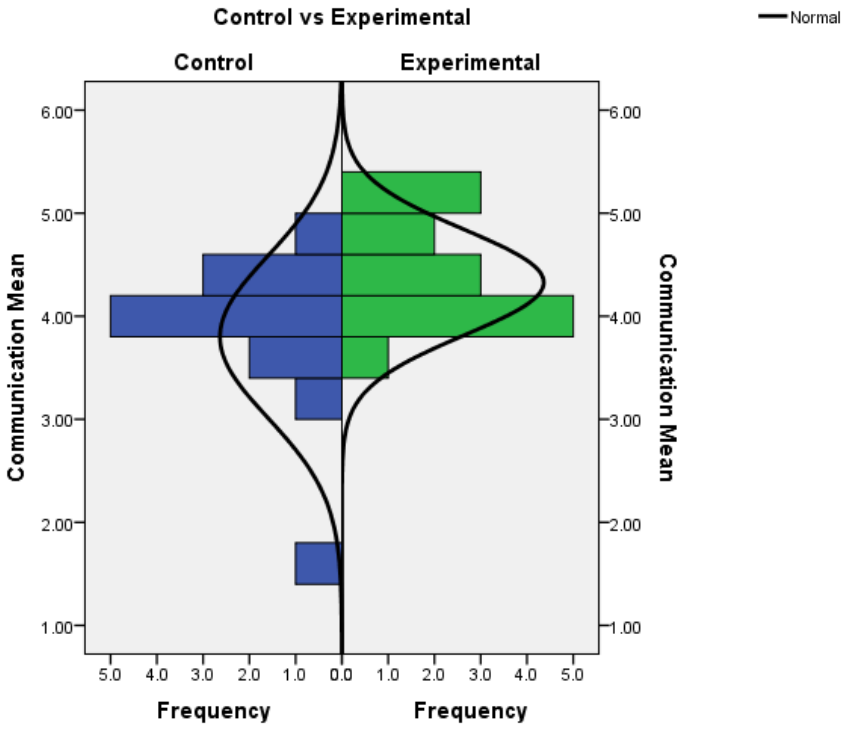

Figure 17: Population Pyramid for Communication score for both groups

From Table 63, we can see there was no statistically significant difference in communication scores between experimental and control, U = 54.00, z=-1.82, p = .08, using an exact sampling distribution for U (Dineen & Blakesley, 1973). That means, individuals participating in the role-play simulation did not have better communication skills than those not participating in the role-play simulation. Thus, hypothesis H1a not supported.

Table 63: Mann-Whitney U Test of Communication scores

Test Statistics	
	Communication
Mann-Whitney U[13]	54.00
Wilcoxon W	145.00
Z	-1.82
Asymp. Sig. (2-tailed)	.07
Exact Sig. [2*(1-tailed Sig.)]	.08[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

H1b: Individuals participating in the role-play simulation will have better perceptual skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in perceptual score between experimental and control groups. Distributions of the perceptual scores for experimental and control were not similar, as assessed by visual inspection from Figure 18.

[13] Consult the **Test Statistics** Table 63 that shows the Mann-Whitney U value given at the intersection of the row labeled Mann-Whitney U and the column labeled with the dependent variable. There are two p values given - one on the row labeled Asymp. Sig (2-Tailed) and the other on the row labeled Exact Sig. [2*(1- tailed Sig.)]. Here, we reported the exact significance as our sample size <20. If the sample size is large, the asymptotic significance value can be used. To determine if there is any significance between the two groups, we look at the exact p value. If the p<.05, we accept our hypothesis; if the p>.05 we reject our hypothesis.

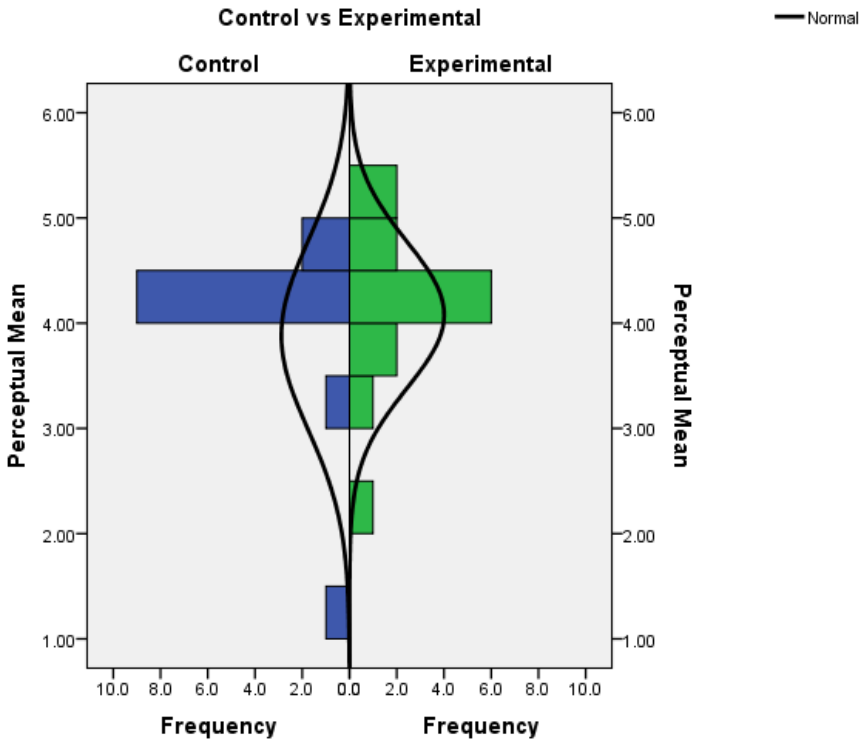

Figure 18: Population Pyramid for Perceptual score for both groups

From Table 64, we can see there was no statistically significant difference in perceptual scores between experimental and control, U=82.00, z =-.44, p>.05, using an exact sampling distribution for U (Dineen & Blakesley, 1973). That means individuals participating in the role-play simulation did not have better perceptual skills than those not participating in the role-play simulation. Thus, H1b hypothesis not supported.

Table 64: Mann-Whitney U Test of Perceptual scores

Test Statistics	
	Perceptual Mean
Mann-Whitney U	82.00
Wilcoxon W	173.00
Z	-.44
Asymp. Sig. (2-tailed)	.66
Exact Sig. [2*(1-tailed Sig.)]	.68[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

H1c: Individuals participating in the role-play simulation will have better thinking skills than those not participating in the role-play simulation.

A Mann-Whitney U test was run to determine if there were differences in thinking score between experimental and control groups. Distributions of the thinking scores for experimental and control were not similar, as assessed by visual inspection from Figure 19.

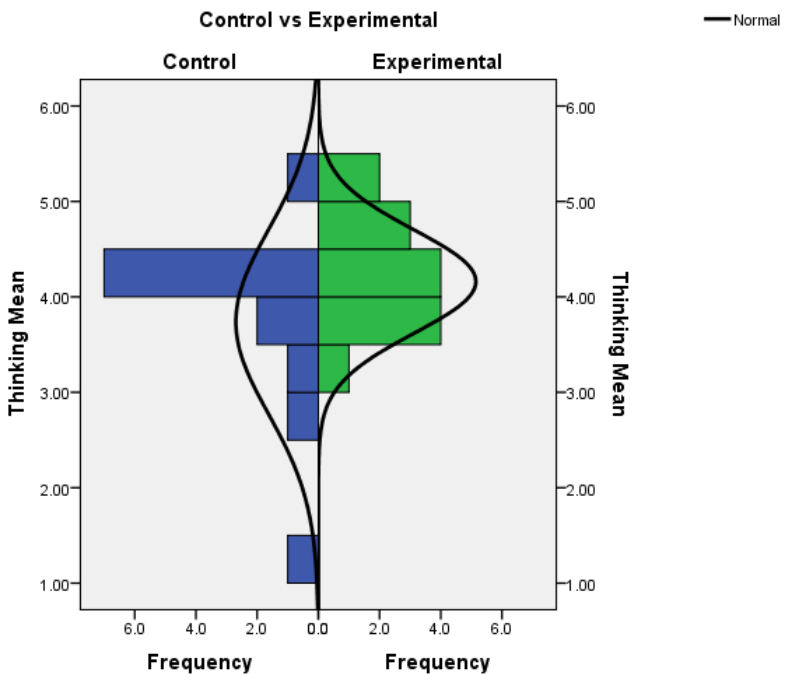

Figure 19: Population Pyramid for Thinking score for both groups

From Table 65, we can see there was no statistically significant difference in thinking scores between experimental and control, U=70.00, z=*-1.02*, p>.05, using an exact sampling distribution for U (Dineen & Blakesley, 1973). In other words, we can say that the students who exposed to the practice session did not develop the stronger thinking skills. This leads us not to accept H1c hypothesis.

Table 65: Mann-Whitney U Test of Thinking scores

Test Statistics	
	Thinking
Mann-Whitney U	70.00
Wilcoxon W	161.00
Z	-1.03
Asymp. Sig. (2-tailed)	.30
Exact Sig. [2*(1-tailed Sig.)]	.32[b]
a. Grouping Variable: Control vs Experimental	
b. Not corrected for ties.	

5.7.3.2 Hypothesis 2

H2: Individuals will demonstrate higher levels of knowledge based skills after interacting with the Behavioral Injection Module.

H2a**:** Individuals will demonstrate higher levels of RE knowledge after interacting with the Behavioral Injection Module.

A Paired sample t-test was run to see if there is any significant difference in RE KL within two groups. From Table 66, we can see that there is a significant difference in the scores for pre RE Knowledge scores (m= 2.4, sd= 0.69) and post RE Knowledge scores (m= 3.66, sd= 0.48); t (12)=6.85, p = 0.00 for control group. Similarly for the experimental group, there is a significant difference in the scores for RE Knowledge scores before using the module (m= 2.44, sd= 0.72) and RE Knowledge scores after using the module (m= 4.16, sd= 0.52); t (13)=11.05, p = 0.001 (Refer to Table 66 & 71).

Specifically, our results suggest that students of both groups exposed to Behavioral Injection Module did gain some knowledge on RE. This leads us to accept H2a hypothesis.

Table 66: Paired Samples Test of RE Knowledge for both Groups

Paired Samples Test										
Control vs Experimental			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Control	Pair 1	Post REKnowledge Mean - Pre REKnowledge Mean	1.21	.64	.18	.83	1.60	6.85	12	.00
Experimental	Pair 1	Post REKnowledge Mean - Pre REKnowledge Mean	1.71	.58	.15	1.38	2.05	11.05	13	.00

H2b: Individuals will demonstrate higher levels of Awareness on RE knowledge after interacting with the Behavioral Injection Module.

We ran Wilcoxon ranked test[14] to determine whether there is a median difference in Awareness on REKL between paired observations. In order to use the Wilcoxon signed-rank test to determine if there is a statistically significant median difference between two related groups, we have shown a histogram chart in Figure 20 to show the shape of the distribution of the differences to be symmetrical. By visually inspecting the shape of the distribution of difference scores, we can see that the scores do appear to be approximately symmetrical and thus we can use the Wilcoxon signed-rank test to analyze our data.

[14] The "**Asymp. Sig. (2-tailed)**" row in the Test Statistics table contains the statistical significance of the Wilcoxon signed-rank test (i.e., the *p*-value). The Wilcoxon signed-rank test is a test of whether the median difference between the related groups is 0 (zero) *in the population*. If the *p*-value is less than .05 (i.e., $p < .05$), you have a statistically significant result (i.e., the median difference is statistically significantly different from 0). If $p > .05$, you do not have a statistically significant result and there is no median difference between the related groups in the population (i.e., the median difference is not statistically significant different from 0).

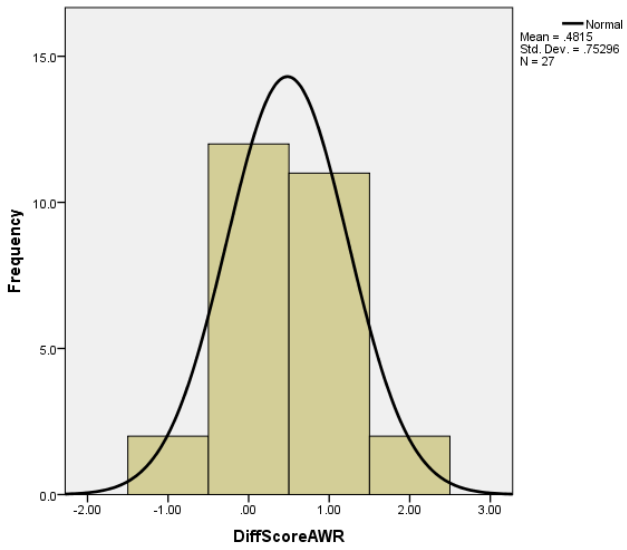

Figure 20: Histogram to show the symmetrical shape of the distribution of Differences in Awareness on REKL Scores.

From Table 67 we see how many participants in both groups had improved their awareness in REKL after reading the module content, how many remained the same, and how many had worse performance.

Table 67: Ranks Table for Awareness on RE Knowledge for both groups

Ranks					
Control vs Experimental			N	Mean Rank	Sum of Ranks
Control	Post Awareness Score - Pre Awareness Score	Negative Ranks	1[a]	3.00	3.00
		Positive Ranks	6[b]	4.17	25.00
		Ties	6[c]		
		Total	13		
Experimental	Post Awareness Score - Pre Awareness Score	Negative Ranks	1[a]	4.50	4.50
		Positive Ranks	7[b]	4.50	31.50
		Ties	6[c]		
		Total	14		
a. Post Awareness Score < Pre Awareness Score					
b. Post Awareness Score > Pre Awareness Score					
c. Post Awareness Score = Pre Awareness Score					

Table 80 shows for control group, 6 out of 13 participants had "positive ranks" which means 6 participants did well in post awareness task than the pre awareness task.

That is the participants who received the module has increased awareness on REKL. There were 6 participants (e.g. the six “Ties”) who did not increase any awareness on REKL even after being exposed to the module.

For the experimental group, 7 out of 14 participants had "positive ranks" which means 7 participants did well in post awareness task than the pre awareness task. That is the participants who received the module has increased awareness on REKL. There were 6 participants (e.g. the six “Ties”) who did not increase any awareness on REKL even after being exposed to the module.

A Wilcoxon signed-rank test determined that there was no statistically significant increase for control group in Awareness on REKL, $z = -1.93$, $p > .05$ (Refer to Table 68). On the other hand, a Wilcoxon signed-rank test determined that there is statistically significant increase for experimental group in Awareness on REKL, $z = -2.12$, $p < .05$ (Refer to Table 68).

Table 68: Test Statistics for Awareness Score of both groups

Test Statistics[a]		
Control vs Experimental		Post Awareness Score - Pre Awareness Score
Control	Z	-1.933[b]
	Asymp. Sig. (2-tailed)	.053
Experimental	Z	-2.121[b]
	Asymp. Sig. (2-tailed)	.034
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		

This implies that the students in both groups did increase awareness on RE knowledge after reading the module content. Thus, H2b hypothesis supported.

5.7.3.3 Hypothesis 3

H3: Task competency demonstrated by the individuals participating in the role-play simulation will be higher than those not participating in role-play simulation

H3a: Individuals participating in the role-play simulation will generate better set of questions than those not participating in the role-play simulation.

We used the independent samples t-test to compare the transcript score of the control group who did not receive the practice session to the transcript score of the experimental group who received the practice session.

From Table 69, we can say that the mean score for the experimental group and the mean score for the control group are statistically significant at 0.05 level {t (25) = 2.82; p=.01)}. This implies that the students who participated in the role-play simulation did prepare a better transcripts than the students who did not. This leads us to accept H3a hypothesis.

Table 69: Independent sample t-test for Transcript Scores

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Transcript Scores	Equal variances assumed[15]	.285	.598	2.823	25	.009	7.01099	2.48353	1.89607	12.12591

[15] Refer to Table 69: If the "Sig." for "Levene's Test for Equality of Variances" is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported otherwise we report the second row which is "Equal variances not assumed" (Holcomb, Z. 2014). Here we have reported "Equal variances assumed" row.

H3b: Individuals participating in the role-play simulation will generate better quality report than those not participating in the role-play simulation.

We used the independent samples t-test to compare the report score of the control group who did not receive the practice session to the report score of the experimental group who received the practice session.

From Table 70, we can say that the report mean score for the experimental group and the report mean score for the control group are statistically significant at 0.05 level {t (25) = 4.09; p<.001)}. This implies that the students who participated in the role-play simulation did prepare a better report than the students who did not participate. This leads us to accept H3b hypothesis.

Table 70: Independent sample t-test for Report Scores

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Report Scores	Equal variances assumed[16]	.01	.91	4.09	25	.00	5.42	1.33	2.69	8.16

We have summarized all the Mean and Median for all the constructs shown in Table 71. From the table, we can see that the experimental group has higher means and medians compare to Control group for all the constructs.

[16] Refer to Table 70: If the “Sig.” for “Levene’s Test for Equality of Variances” is greater than .05, it is appropriate to assume equality of variances and the statistics for t test in the top row should be reported otherwise we report the second row which is “Equal variances not assumed” (Holcomb, Z. 2014). Here we have reported “Equal variances assumed” row.

Table 71: Mean and Median Table for Study IV

Outcome	Experimental						Control					
	Pre Mean	SD	Median	Post Mean	SD	Median	Pre Mean	SD	Median	Post Mean	SD	Median
Communication				4.32	.51	4.2				3.80	.79	4.00
Perceptual				4.08	.70	4.10				3.88	.90	4.00
Thinking				4.16	.54	4.12				3.74	.96	4.00
REKL	2.44	.72	4.00	4.16	.52	4.00	2.45	.69	2.40	3.66	.48	3.80
AWR on REKL	3.93	.47	4.00	4.36	.63	4.00	3.77	.83	4.00	4.31	.75	4.00
Transcript				15.86	6.63	16.50				8.85	6.24	9.00
Report				16.46	3.24	17.25				11.04	3.65	11.00

6. Discussions and Conclusions

6.1 Summary of Results and Implications

Our goal is to prepare the students as an analyst in the classroom environment with their required Soft skills and to introduce a systematic procedure in IS curriculum and pedagogy that will impart such skills. With that in mind, we developed and implemented BIM in Spring-Summer 2015, and experimented Behavioral Injection Module (BIM) from Fall 2015 onwards. We ran our experiment both as an in-class and online assignment during Fall 2015, Spring 2016, Summer 2016 and Spring 2017 semesters. Our BIM approach is particularly focused on developing knowledge-based skills and learning performance besides three soft skills.

From the previous chapter, we obtained mixed results for our studies. We have summarized our results in Table 72. Our overall findings may not support all the hypothesis but there was a trend of improvement. At least some of the results of our studies, showed the trend of enhancing better knowledge in RE topics and particularly in question techniques in later studies. The results showed that the participants became more aware of REKL by using this BIM approach compared to the traditional class lecture with no practice session. The role-play simulation part of the BIM has shown prospects. And few of our results showed that it can moderate the relationship between the individual and their learning performance and knowledge based skills. From all four studies, we can see there may not have been no improvement on the soft skills but using the BIM and the role play simulation there were improvement in learning performance and the knowledge based skills from study I, III and IV. We will now discuss our three research questions that we proposed in this dissertation.

Table 72: Summary Results of all Studies

Constructs	Study I		Study II		Study III		Study IV	
	Test Result	**Hypothesis Status**	**Test Result**	**Hypothesis Status**	**Test Result**	**Hypothesis Status**	**Test Result**	**Hypothesis Status**
Communication	n.s[17] (p>.05)	Hypothesis 1 not supported	n.s (p>.05)	Hypothesis 1 not supported	n.s (p>.05)	Hypothesis 1 not supported	n.s (p=.076)	Hypothesis 1 not supported
Perceptual	n.s (p>.05)		n.s (p>.05)		n.s (p>.05)		n.s (p=.685)	
Thinking	n.s (p>.05)		n.s (p>.05)		n.s (p>.05)		n.s (p=.325)	
REKL	n.s (p>.05)	Hypothesis 2 not supported	Sig. (p<.05)	Hypothesis 2 not supported	Sig. (p<.05)	Hypothesis 2 supported	Sig. (p<.001)	Hypothesis 2 supported
AWR in REKL	n.s (p>.05)		n.s (p>.05)		Sig. (p<.05)		Sig. (p<.05)	
RE Performance (Transcript)	N/A	N/A	N/A	N/A	Sig. (p<.05)	Hypothesis 3 supported	Sig. (p<.05)	Hypothesis 3 supported
RE Performance (Report)	Sig. (p<.05)	Hypothesis 3 supported	n.s (p>.05)	Hypothesis 3 not supported	Sig. (p<.05)		Sig. (p<.001)	

Q1- Can students' soft skills be developed through the introduction of the role-play simulation task of the Behavioral Injection Module approach?

The descriptive statistics of our measuring constructs and their corresponding graphs of three soft skills, in the results section show that there is a slight difference between the control and the treatment group (higher means). That means the treatment group who were exposed to the role play simulation task did develop better soft skills than the control group with no role-play task. But the parametric tests show that there is no statistically significant difference between the two groups (p>.05). Because of the smaller sample size, we are not seeing the significant difference. And that is why we failed to accept the hypothesis H1a, H1b & H1c based on the outcome of the parametric tests. But

[17] Here 'Sig.' representing significant and 'n.s' representing non-significant.

with broader samples, there may be positive effects on the soft skills of the participants through the introduction of the role-play simulation task of the BIM approach in future.

Q2- Can students' learning performance related to RE be improved through the introduction of Behavioral Injection Module approach?

Some of the test statistics in our studies, did support our hypothesis H2a and H2b. There were a significant difference between the two groups. Both groups did gain some REKL and became aware on REKL after using the BIM. That means the parametric test results show that the students' learning performance related to RE can be improved through the introduction of BIM approach. Therefore, our research question#2 has a conceivable answer.

Q3- Will the introduction of the Behavioral Injection Module increase the quality of the requirements analysis in the IS students?

Our test results for the Requirements Quality (e.g. transcript preparation and the report writing) shows that the treatment group who did the role-play simulation task have done better than the group who did not do the role-paly simulation task. That is the participants who were exposed to the role-play task of the BIM approach, tend to prepare better transcripts which lead to that they have better knowledge about the proper interview question techniques that an analyst required to know for a successful project. This knowledge also help the participants to write better report. The test statistics show that there is a statistically significant difference between the two groups. So we can conclude that the quality of the requirements analysis can be increased with the introduction of practice session task of the BIM. Therefore, our research question#3 has a conceivable answer.

In this dissertation, we proposed a research model that our BIM will moderate the relationship between the individual and the learning performance and the soft skills. As in today's IT industry, expectations on soft skills for an analyst role besides technical skills are high and in critical demand. We proposed such module based BIM that can help the IS students in class to practice such soft skills in order to meet the industry demand. The role-play simulation task of the BIM not only help them to learn the proper interview question technique but also help them to practice in classroom environment before they go out in practical field. In the process of their practice, the BIM will help them to develop such three skills. Moreover, our BIM is developed based on module approach. As in the literature review chapter we saw that the module concept helps the individuals to engage more and maximize the learning experience. The module is also for stand-alone use with minimal instructor's involvement. We have developed our BIM in such that it can be used by any courses who wish to inculcate any kind of skills development through role-play simulation in the classroom environment. During our studies, BIM was only introduced in the beginning of the assignment with proper guidelines and instructions. Later throughout the assignment no instructor's involvement was required. Our BIM was a functional one with minimal supervision.

Therefore, from the results of four studies we can conclude that the students who were exposed to our BIM has improved their knowledge skills and learning performance. In particular, the module helped the students to gather the knowledge about the RE process, question techniques. The role play simulation task actually helped the students to practice with the interview questions techniques. Our dissertation has tested the two propositions through the four empirical studies. We can conclude that the use of role play simulation

did have a positive effect on the learning performance and the knowledge-based skills of an individual. As a whole, the BIM approach helped the students to prepare as an industry-ready analysts in the classroom. We hope that our proposed concept of using module based approach with the role-play simulation activity in the BIM will help not only the IS pedagogy and curriculum board but also to the individuals who are IS professionals and would like to prepare themselves for such analyst role outside classroom. We hope that the research model proposed here can be integrated in the IS pedagogy and curriculum education to nurture and prepare industry ready analyst in the classroom environment.

6.2 Limitations

We would like to recognize our limitations that we faced during the empirical studies. We believe because of these issues, the expected outcome varied at different times. The limitations are as follows:

- **Time Factor**: The time frame was a limitation. The class hour was one hour and fifteen mins. We had to adjust our module activity to fit that time so that the participants can able to complete it. Our observation says, most of the participants were trying to complete the BIM activity as fast as possible because of this time limitation which we believe lead to a poor result.
- **Extra Credit Work**: In some instances, BIM activity was presented in the form of an extra credit assignment. It was instructed by the respective instructors of the classes that if attempted, they would receive full points in regardless whether it is correct or not. Therefore, this is also another factor that led the participants to complete it in haphazard manner and most of them did not even bother of attempting, as they did not feel it was important. This led to reduce

the sample size than the actual participants in the assigned class. There were cases where only 25% of the total students attempted and completed the BIM assignment properly.

- **Sample Size**: Another big factor for our results not being as positive as expected, is the small sample size that we have for all three studies we conducted (n<50). That does not mean our module did not have any effect on participants' overall learning performance, knowledge-based skills and soft skills development. However, based on our study we believe, a larger sample size would strongly support our claims. We would like to run our BIM in more classes. This is going to be one of our future works.
- **Quiz Normality Test Outcome**: For in–class activity, we added the quiz that has the similar questions for the Awareness on REKL construct. Instead of giving it as a part of the survey, we provided it to the class as a quiz. The quiz was given just after the reading task of the BIM exercise. In higher education, such test, quiz, or academic scores tend to be not normally distributed. So it is not a bad thing that our Quiz score is not normally distributed.
- **Availability of Classes**: It was hard, at times, where we could not get hold of one full IS class to run the module physically. It was also not easy to get the IS classes. So we ran our experiment in CIS Department classes that were available in Towson University.
- **Report and Transcript Outcome**: Even though in some studies, report and transcript grade did not show any differences; perhaps the rubric that we used

was not sensitive enough to some of the differences that we observed qualitatively.

6.3 Future Work

While our findings have interesting implications, we strongly feel that more studies in broader samples need to be done in future specially across IS courses. We would like to emphasize more on improving the individual items of the soft skills constructs in order to get the positive outcome. As we had fewer samples to work with, we did not get the expected outcome for our first proposition. We therefore, need to run our experiment in broader samples to see the positive changes in soft skills of the participants. In future, when we conduct our experiment on broader samples, we may see some effect on developing soft skills after exposing to BIM. In addition, we also want to work on the usability of the BIM in future to make it more interactive and functional with a minimal supervision.

Appendices

APPENDIX A

1. Instruments

Soft Skills (Sources)	**Items**
Communication Skills (Bassellier and Benbasat 2004; Lee, Trauth and Farwell 1995)	In general, how would you rate your ability to effectively conveying verbal information? In general, how would you rate your ability to effectively conveying written information? In general, how effective do you think you are at communicating with people on a one to one basis? In general, how effective do you think you are at communicating ideas to a group of people? How effective are you at working in a team environment? How well can you communicate about IT matters in non-technical language and within a business context to non-IT specialists? How would you rate your ability to listen attentively? In general how you would you rate your ability to respond to others' comments effectively during communication?
Analytical skills (Multi-rater instrument measuring problem solving skills (Lohman 2004))	**Self-Assessment Items**
Problem Identification	I readily focus on important problems. I consider relevant factors when analyzing a problem. I have difficulty in setting priorities about which work problem I should address. I am able to accurately describe work problems to others.
Goal Selection	I obtain information from others to help set goals for resolving challenging problems. I establish appropriate goals for resolving problems. I prioritize the goals that I have set for resolving problems. I do not consider how others will be affected if the goals that I set are achieved.
Generation of Alternative Solutions	I generate two or more possible solutions when dealing with a problem. The possible solutions that I identify address the real causes of problems. The possible solutions that I identify reflect an understanding of underlying concepts and issues related to a problem. I tend to generate idealistic rather than realistic solutions to problems.
Consideration of consequences associated with Alternative solutions	I recognize positive consequences associated with possible solutions to problems. I tend to overlook negative consequences associated with possible solutions to problems. I am not concerned about the short-term consequences associated with implementing possible solutions. I consider the long-term consequences associated with implementing possible solutions.
Approach to Decision-Making	I select a solution only after considering all possible consequences associated with possible solutions.

	I procrastinate when making decisions regarding the selection and implementation of solutions. I take responsibility for the decisions that I make. The decisions that I make are in the best interests of those I serve and work with. I am good at identifying political implications of decisions to be made. I generally know the ethical implications of the decisions to be made.
Implementation of Solutions	I tend to misjudge the resources that are required to implement solutions. I implement solutions in a timely manner. I implement solutions in an effective manner. I overlook unanticipated situations that arise during the implementation of my solutions.
Evaluation of Solutions	I seldom follow up after solutions have been implemented to determine their effectiveness. If goals were not achieved, I reflect on whether the problems were identified correctly. I accept responsibility for my contributions to successfully solving problems. Someone else is generally responsible when solutions to problems are not successful.
Perceptual Skills (Klegeris & Hurren, 2011)	Items will be Adapted from Klegeris & Hurren, 2011

Absorption of Knowledge (Chakraborty Dissertation paper**)**	I did not have to learn a lot of new things in this project. I found it easy to learn the new things needed to do my work in this project. I know much more than I did at the beginning of the project. If I had not learnt new things, I would not have been able to complete the project. Learning new things was critical to the success of the project. I found the project challenging as I had to learn a lot of new things. I found it very difficult to process all the new information that I came across in this project. I found it easy to acquire new knowledge necessary to be productive in this project. I felt that I did not manage to learn new things in this project. I found it difficult to keep abreast of new information in this project.
Application of Knowledge (Chakraborty, 2008**)**	It was very easy for me to apply my knowledge in this project. I could easily use my store of knowledge in doing my work. It was difficult for me to figure out how to use my knowledge to do the work in this project. I very frequently needed to bank on my existing knowledge to do the work in my project. I believe I was successful in this project because I could use what I know to do my work in this project. I found it difficult to understand what information that I possessed could be applied in this project. I could not apply any of my existing knowledge in this project. I felt my store of relevant knowledge was inadequate for this project. I was not always sure what information I possessed directly applied to this project.

	It was hard for me to use my existing understanding to do the work in the project.
Technical Knowledge (Lee, Farwell & Trauth, 1995**)**	**Items (Will be adapted for ISD Knowledge measurement)**
Explicit IT Knowledge (Bassellier, Benbasat and Reich, 2001)	Rate your Knowledge about technologies such as personal computers, client/server computing, LAN and multimedia Rate your Knowledge about existing technology portfolio in business area Rate your Knowledge about how applications such as e-mail, intranet, and groupware can be valuable to your client's organization Rate your Knowledge about different development methodologies such as traditional system development lifecycles, end user development, prototyping, and access to service providers Rate your Knowledge about IT Strategies policies and vision statements used in your clients organization Rate your Knowledge about IT-Knowledgeable people within or outside your team Rate your Knowledge about secondary sources of IT knowledge (Internet, Journal etc.) Rate your Ability to learn new Technologies Rate your Ability to focus on new technologies as means not ends Rate your Ability to understand technological trends
General IT Knowledge (Bassellier, Benbasat and Reich, 2003**)**	Rate your ability/Knowledge of the following - Third Generation Languages Telecommunications Networks (e.g. LAN, WAN etc.) Operating systems 4th Generation Languages Client Server Computing System Development Lifecycles End user development Prototyping System Integration System Analysis/Structured analysis Systems Lifecycle Management Relational Databases Distributed Processing Data Management Case Methods/ Tools Decision Support systems Assembly Languages Expert Systems/ AI
Individual Traits	**Items (Will be adapted from Big Five Personality Framework)**
	Big Five Personality Factor are as follows: 1. Extraversion 2. Agreeableness 3. Conscientiousness 4. Neuroticism (Emotional Stability) 5. Openness to Experience

APPENDIX B

1. Informed Consent Form

Dear Participant:

My name is Atiya Afsana and I am a doctoral student in the Department of Computer and Information System at Towson University. As a part of my research dissertation, I want to conduct an experiment in the classroom to examine the improvement of the soft skills of an analyst role among IS students. To conduct such experiment, I will be introducing a pedagogy approach called Behavioral Injection Module (BIM) which will be used to the undergraduate IS courses.

Participation in this research is voluntary. If you choose to participate in this research, you will be asked to respond to a survey where you will be asked to reflect on the Requirements Elicitation process. That is, how an analyst role elicit system requirements using question techniques, from the clients using the module. This survey should not take you more than 15 minutes. You may discontinue your participation in the survey at any time and it will not affect your grade or status. If you do choose to participate in this research, your responses will be anonymous and anyone reading the results will not be able to identify you. All information will remain strictly confidential. Although the descriptions and findings may be published, at no time will your name be used.

If you have any questions about the project, you may contact Dr. Suranjan Chakraborty (410-704- 4769, schakraborty@towson.edu) or the Chairperson of Towson University's Institutional Review Board for the Protection of Human Participants, Dr. Debi Gartland, at (410) 704-2236. A copy of the survey results, reported in aggregate form, will be available to you upon request.

Thank you for your time and willingness to participate in this exercise.

Date: _____

Participant: _____

Witness: _____

APPENDIX C

1. Pre Survey Questionnaires (2015)

1. What is your age?
    a. 20 years or younger
    b. 21-25 years
    c. 26-30 years
    d. 31 years or older

2. What is your current student standing?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Other

3. What is your current GPA? _____

Knowledge about Requirements Elicitation (RE) Process

1. Are you familiar with the term 'System Analyst'? Yes No

2. Are you familiar with the term 'Requirements Elicitation' process? Yes No

3. Are you aware about that the Analyst plays an important role in collecting requirements from the clients in system development process? Yes No

4. Do you know that the interview is one of the most important way to collect requirements for a new system by the analysts? Yes No

Interest on Requirement Elicitation (RE) Process

1. Would you describe yourself as an expert in Requirements Elicitation (RE) Process?

Extremely Unlikely	Unlikely	Neutral	Likely	Extremely Likely
1	2	3	4	5

2. How likely is it that you read magazine or newspaper articles related to Requirements Elicitation process?

Extremely Unlikely	Unlikely	Neutral	Likely	Extremely Likely
1	2	3	4	5

3. For the success of the system development, how important is learning Requirements Elicitation process?

Not at all Important	Of Little Importance	Neutral	Important	Most Important
1	2	3	4	5

4. How important is for you to learn new ways of questioning techniques for Requirement Elicitation process?

Not at all Important	Of Little Importance	Neutral	Important	Most Important
1	2	3	4	5

5. How much interest do you have in learning the Requirements Elicitation process?

Not at all	Very Little	Neutral	Somewhat	To a Great Extent
1	2	3	4	5

6. How important do you think Requirement Elicitation knowledge is to future career as an Analyst?

Not at all Important	Of Little Importance	Neutral	Important	Most Important
1	2	3	4	5

Awareness of the Requirement Elicitation (RE) Process

1. What are the possible reasons of insufficient requirements elicited from the clients for a new system?

a) Lack of communications skills

b) Lack of questions techniques

c) Lack of cognitive reasons

d) All of the above

2. Who collects the requirements for the new system?

a) Developer

b) Programmer

c) Analyst

d) None of the above

3. What qualities do analysts need to possess?

a) Technical skills

b) Communication skills

c) Problem- solving skills

d) All of the above

4. Requirements Elicitation is a ….

a) Process of collecting complete requirements for a new system

b) Process of elicitation of functional and non-functional requirements

c) Both a and b

d) None of the above

5. Where does the Requirement Elicitation phase fit in when developing a software product?

a) After design

b) During testing

c) After implementation

d) Before design

6. Which mistake is one of the major causes of System Development project failure?

a) Incomplete and Inaccurate requirements for a new system

b) Cost

c) Lack of resources

d) None of the above

2. Post Survey Questionnaires (2015)

Knowledge about Requirements Elicitation (RE) Process

Statement	Not at All Knowledgeable	Slightly Knowledgeable	Moderately Knowledgeable	Very Knowledgeable	Extremely Knowledgeable
1. Rate your Knowledge about Requirements Elicitation (RE) process.					
2. Rate your Knowledge about, how questioning techniques for RE can be valuable to your client's organization.					
3. Rate your Knowledge of the following – Prompting Techniques					
4. Rate your Knowledge of the following – Analyst Tasks					
5. Rate your Knowledge of the following – Soft Skills of an Analyst					

Absorption of Knowledge

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I did not learn a lot of new things in this exercise					
2. I found it easy to learn the new things needed to do my work in this exercise					
3. I know much more than I did at the beginning of the exercise					
4. If I had not learn new things, I would not have been able to complete the exercise					
5. Learning new things was critical to the success of the exercise					
6. I found the exercise challenging as I had to learn a lot of new things					

7. I found it very difficult to process all the new information that I came across in this exercise					
8. I found it easy to acquire new knowledge necessary to be productive in this exercise					
9. I felt that I did not manage to learn new things in this exercise					
10. I found it difficult to keep abreast of new information in this exercise					

Application of Knowledge: Please rate your agreement with each statement after using the module and completing the report writing exercise.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. It was very easy for me to apply my knowledge to complete this report writing exercise					
2. I felt my store of relevant knowledge was inadequate for this report writing exercise					
3. It was difficult for me to figure out how to use my knowledge to do the work in this report writing exercise					
4. I frequently needed to bank on my existing knowledge to do the work in my report writing exercise					
5. I believe I was successful because I could use what I know to do my work in this report writing exercise					
6. I found it difficult to understand what information that I possessed could be applied in this report writing exercise					
7. I could not apply any of my existing knowledge in this report writing exercise					
8. I was not always sure what information I possessed directly applied to this report writing exercise.					
9. It was hard for me to use my existing understanding to do report writing exercise					

Awareness of the Requirement Elicitation (RE) Process

1. What are the possible reasons of insufficient requirements elicited from the clients for a new system?

a) Lack of communications skills

b) Lack of questions techniques

c) Lack of cognitive reasons

d) All of the above

2. Who collects the requirements for the new system?

a) Developer

b) Programmer

c) Analyst

d) None of the above

3. What qualities do analysts need to possess?

a) Technical skills

b) Communication skills

c) Problem- solving skills

d) All of the above

4. Requirements Elicitation is a ….

a) Process of collecting complete requirements for a new system

b) Process of elicitation of functional and non-functional requirements

c) Both a and b

d) None of the above

5. Where does the Requirement Elicitation phase fit in when developing a software product?

a) After design

b) During testing

c) After implementation

d) Before design

6. Which mistake is one of the major causes of Information System Development (ISD) project failure?

a) Incomplete and Inaccurate requirements for a new system
b) Cost
c) Lack of resources
d) None of the above

Please indicate your level of agreement with the following statements

Usability					
Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Instructions to use the module were clear.					
I found it easy to navigate around the module.					
The module is easy to launch					
The fonts, colors, and sizes are consistent throughout the module					
The module maintains an appropriate level of consistency in its design from one part/section of the module to another.					
I found the interface clear, structured and appealing.					
Text and graphics are legible.					
Fonts (style, color, saturation) are easy to read.					
The module does not provide too many long sections of text to read without meaningful interactions					
The module engaged me in interactive tasks that are closely aligned with the learning goals and objectives					
The module used interactive activities to gain the attention, sustain the interest, and maintain my motivation.					
Questions in the module enhanced my understanding of Requirements Elicitation process, ideas and concepts.					
The module provides guidance and support to complete individual sections including learning activities					

User's Satisfaction					
Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I was able to complete the module quickly					
I was able to effectively complete the module					
It was simple to use the module					
I was satisfied with the module					
Additional Comments:					

3. Pre Survey Questionnaires (2016)

Please answer the following questions:

1. What is your age?
    a. 20 years or younger
    b. 21-25 years
    c. 26-30 years
    d. 31 years or older
2. What is your gender?
    a. Male
    b. Female
3. What is your current student standing?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Other
4. What is your major?
    a. Information Systems or Computer Information Systems
    b. Computer Science
    c. Computer Technology or Information Technology
    d. Mathematics
    e. Undecided
    f. Other

Please rate your agreement with each statement.

Statement	Not at All	Slightly Knowledgeable	Moderately Knowledgeable	Very Knowledgeable	Extremely Knowledgeable
1. Rate your Knowledge about Requirements Elicitation (RE) process.					
2. Rate your Knowledge about Prompting Techniques.					
3. Rate your Knowledge about Analyst Tasks.					
4. Rate your Knowledge about the critical Soft Skills needed by an Analyst.					
5. Rate your Knowledge about the value of interviewing techniques for eliciting requirements.					

Please answer the following questions related to RE Process.

1. What are the possible reasons of insufficient requirements elicited from the clients for a new system?

a) Lack of communications skills

b) Lack of questions techniques

c) Lack of cognitive reasons

d) All of the above

2. Who collects the requirements for the new system?

a) Developer

b) Programmer

c) Analyst

d) None of the above

3. What qualities do analysts need to possess?

a) Technical skills

b) Communication skills

c) Problem- solving skills

d) All of the above

4. Requirements Elicitation is a ….

a) Process of collecting complete requirements for a new system

b) Process of elicitation of functional and non-functional requirements

c) Both a and b

d) None of the above

5. Where does the Requirement Elicitation phase fit in when developing a software product?

a) After design

b) During testing

c) After implementation

d) Before design

6. Which mistake is one of the major causes of System Development project failure?

a) Incomplete and Inaccurate requirements for a new system

b) Cost

c) Lack of resources

d) None of the above

4. Post Survey Questionnaires (2016)

Now that you have exposed to this Behavioral Injection Module (BIM), please reconsider your answers to the following questions.

Knowledge about Requirements Elicitation (RE) Process: Please rate your agreement with each statement after using the module.

Statement	Not at All	Slightly Knowledgeable	Moderately Knowledgeable	Very Knowledgeable	Extremely Knowledgeable
1. Rate your Knowledge about Requirements Elicitation (RE) process.					
2. Rate your Knowledge about Prompting Techniques.					
3. Rate your Knowledge about Analyst Tasks.					
4. Rate your Knowledge about the critical Soft Skills needed by an Analyst.					
5. Rate your Knowledge about the value of interviewing techniques for eliciting requirements.					

Awareness of the Requirement Elicitation (RE) Process: After using the module, now answer the following questions related to RE Process. Circle your answer.

1. What are the possible reasons of insufficient requirements elicited from the clients for a new system?

a) Lack of communications skills

b) Lack of questions techniques

c) Lack of cognitive reasons

d) All of the above

2. Who collects the requirements for the new system?

a) Developer

b) Programmer

c) Analyst

d) None of the above

3. What qualities do analysts need to possess?

a) Technical skills

b) Communication skills

c) Problem- solving skills

d) All of the above

4. Requirements Elicitation is a ….

a) Process of collecting complete requirements for a new system

b) Process of elicitation of functional and non-functional requirements

c) Both a and b

d) None of the above

5. Where does the Requirement Elicitation phase fit in when developing a software product?

a) After design

b) During testing

c) After implementation

d) Before design

6. Which mistake is one of the major causes of System Development project failure?

a) Incomplete and Inaccurate requirements for a new system

b) Cost

c) Lack of resources

d) None of the above

Absorption of Knowledge: Please tell us how much knowledge you have gathered related to RE process after using the module. Rate your agreement with each statement.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I did not learn a lot of new things after using this module					
2. I was able to learn about questions techniques from using this module					
3. I know now much more about the RE process and questions techniques than I did at the beginning of this module					

4. If I had not learnt new things from using this module, I would not have been able to complete the specification report					
5. I found it very difficult to process all the new information that I came across in this module					
6. What I have learned from the module was easy for me to complete the specification report.					
7. I found it easy to acquire new knowledge necessary to be productive in the report writing exercise from using the module					
8. I found it difficult to keep abreast of new information that I came across in this module.					

Communication Skills: Please indicate your level of agreement with the following statements after using the module.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The Behavioral Injection Module (BIM) helped me to learn how to ask questions to get requirements from clients.					
2. After working with the BIM, I was able to choose effectively from different prompting techniques to elicit requirements from clients.					
3. The practice session helped me to improve the proper way of asking the right questions in order to get the needed responses from the clients.					
4. After using the BIM, I feel confident that I can now effectively interview clients to elicit requirements.					
5. After using the BIM, I feel that I can effectively interact with clients to elicit requirements					
6. After using the BIM, I feel that it was not very useful in helping me learn how to interview clients to elicit requirements.					

Thinking Skills: Please indicate your level of agreement with the following statements after using the module.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. After the module activity, I feel confident that I can develop appropriate requirements from analyzing client responses to questions					
2. After the module activity, I feel confident that I can assess missing requirements/information from analyzing client responses to questions					
3. The activity in the module was not helpful for understanding the requirements from the clients responses					
4. After the module activity, I feel I am able to assess what questions to ask to get missing requirements based on analyzing the client's response to questions					
5. After the module activity, I feel confident that I can develop complete requirements from analyzing client responses to questions					

Perceptual Skills: Please indicate your level of agreement with the following statements after using the module.

Statement- Sense Making	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Using the module, I can now determine what mistakes in questioning techniques can lead to gathering incomplete RE specifications					
2. After using the module, I can now quickly identify mistakes in questioning the clients so that they won't be repeated					
3. After using the module, I can summarize my learning about what works well in successfully questioning clients and gathering requirements.					
4. After using the module, I can tell what the consequences are when mistakes are made in questioning clients to gathering requirements.					

Statement- Information Gathering	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The practice session was the enough resource to write the report					
2. The practice session was not helpful in collecting all the requirements for the report.					
3. The information I gathered from the questioning practice session, provided me with enough to prepare the report.					
4. The practice session helped me to identify the appropriate requirements for the report.					
5. The practice session was not enough to derive the proper information for the report.					

5. Pre Survey Questionnaires (2017)

Please answer the following questions:

1. What is your age?
    a. 20 years or younger
    b. 21-25 years
    c. 26-30 years
    d. 31 years or older
2. What is your gender?
    a. Male
    b. Female
3. What is your current student standing?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Other
4. What is your major?
    a. Information Systems or Computer Information Systems
    b. Computer Science
    c. Computer Technology or Information Technology
    d. Mathematics
    e. Undecided
    f. Other

Please rate your Knowledge about each statement.

Statement	Not at All Knowledgeable	Slightly Knowledgeable	Moderately Knowledgeable	Very Knowledgeable	Extremely Knowledgeable
1. Knowledge on Requirements Elicitation process.					
2. Knowledge on Prompting Techniques.					
3. Knowledge on Analyst Tasks.					
4. Knowledge on the critical Soft Skills needed by an Analyst.					
5. Knowledge on interviewing techniques for eliciting requirements.					

Please answer the following questions related to Requirements Elicitation (RE) Process.

1. Requirements Elicitation is a ….

a) Process of collecting complete requirements for a new system

b) Process of determining or extracting software requirements

c) Both a and b

d) None of the above

2. Who collects the requirements from the clients for the new system?

a) Developer

b) Programmer

c) Analyst

d) None of the above

3. Where does the Requirement Elicitation phase fit in when developing a software product?

a) After modelling phase

b) During analysis phase

c) After implementation phase

d) Before modelling phase

4. What are the possible reasons of insufficient requirements elicited from the clients for a new system?

a) Lack of communications skills

b) Lack of questions techniques

c) Lack of cognitive reasons

d) All of the above

5. Which is one of the most common problems that hinder the identification of the clients' requirements?

a) Poor Communication

b) Cost

c) Lack of resources

d) None of the above

6. Post Survey Questionnaires (2017)

Now that you have exposed to this Behavioral Injection Module (BIM), please reconsider your answers to the following questions.

Please rate your knowledge with each statement after using the module.

Statement	Not at All Knowledgeable	Slightly Knowledgeable	Moderately Knowledgeable	Very Knowledgeable	Extremely Knowledgeable
Knowledge on Requirements Elicitation (RE) process.					
Knowledge on Prompting Techniques.					
Knowledge on Analyst Tasks.					
Knowledge on the critical Soft Skills needed by an Analyst.					
Knowledge on interviewing techniques for eliciting requirements.					

Please indicate your level of agreement with the following statements after using the module.

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I learned now how to ask questions to get requirements from clients.					
I was able to learn effectively the structured interview guidelines to elicit requirements from clients.					
The module helped me to improve the proper way of asking the right questions in order to get the needed responses from the clients.					
I feel confident that I can now effectively interview clients.					
I feel that I can effectively interact with clients to elicit requirements.					
The RE exercise was helpful for understanding the requirements from the clients responses.					

I feel confident that I can develop appropriate requirements from analyzing client responses to questions.					
I feel confident that I can assess what categories of questions needed to prepare the requirement specification report.					
I feel I am able to assess what questions to ask and how much to ask to get the complete requirements.					

I can now determine what mistakes in questioning techniques can lead to gathering incomplete RE specifications.					
I can now quickly identify mistakes in questioning the clients so that they would not be repeated.					
I can summarize my learning about what works well in successfully questioning clients and gathering requirements.					
I can tell what the consequences are when mistakes made in questioning clients to gather requirements.					
The RE exercise was the enough resource to prepare for the specification report.					
The information I gathered from the module, provided me with enough to prepare the report.					
I was able to identify the appropriate technique to ask questions to elicit the requirements.					
Additional Comments:					

7. Report Template (2015)

Instructions: This is a Requirement Specification Template. Write your name on the top. Now you need to respond to the following questions based on the recently concluded interactions with the dialogue system. You will need the transcripts that you saved during the practice session for this report writing. Please ensure that your responses are clear, concise and cover detailed information of the KMC Car Rental Company. You may use bullet points. You need to write the answers in your own word and can use bullet features to outline your answers. Once you are done, submit your work (both transcript and this report!)

Objectives/Goals ~

1. What have you learnt about the organization?
2. What are the stated goals and objectives about the proposed system?
3. What are the different stakeholders that have been identified?

Processes~

4. What are the different current work processes in the organization?
5. Can you map the different stakeholders to the different processes?

Tasks~

6. What do you know about the different tasks that need to be carried out under each work processes?
7. Can you associate these tasks with the different stakeholders?

Information~

8. Did you find any requirement related to information level? (If yes, then mention below)

8. Report Template (2017)

This is a *Requirement Specification Template*. Here you need to respond to the following questions based on the KMC Car Rentals case. Use the Transcripts to complete this template. Please ensure that your responses are clear and concise.

Write the Prompting technique questions for the following requirements (mention one substantive type question and one procedural type question for each response)

Requirement#1 The KMC currently has paper-based car rental system. Each rental activity is recorded by hand on paper. When a customer wants to rent a car, he either visits the premise or make a phone call, talks with the customer care agent who writes down the necessary information on paper form. The agent also checks the hand written checklist for the availability of the desired vehicle, its rates, and its servicing and maintenance information. Customers have the access to the paper checklist for vehicle selection process. The agents keep track of all the vehicles on the paper. Even the company and staff information and their reports are noted down in handwritten documents. Managing the vehicle service center and tracking the vehicle inventories are being recorded by hand on paper. Customers were aware about the deals or coupons from the flyers that are on the desk in the company premise.

Question Category Type (Goal/Process/Task level):

Procedural Type:

Substantive Type:

Requirement#2 The company has the current work processes: Operational Department has customer service and vehicles management processes. The Management department has the resource management and report management processes.

Question Category Type (Goal/Process/Task level):

Procedural Type:

Substantive Type:

Requirement#3 The company has four work processes: customer service, vehicles management, the resource management and report management. In the customer service process, following items are involved- tracking customer orders, browsing vehicle information, reserving and booking vehicles, browsing periodic offers and deals, helpline over the phone, collecting hand written feedbacks from the customers, managing and viewing previous history, and registering. The vehicle management process includes the management of the vehicle inventory, tracking rental rates, vehicle servicing, cleaning and maintenance. For resource management process, the following items are involved: managing staff, maintaining staff performance reports. And the report management process includes: company revenue report generation, approving vehicle information, managing user authorization, staff performance report generation, company offers, deals and coupons preparation and company budget management.

Question Category Type (Goal/Process/Task level):

Procedural Type:

Substantive Type:

Requirement#4 For customer service process, the tasks of reservation will be handled by both the operational staffs and the customers itself. The operational staffs will also handle the other tasks such as updating, managing the customer information, its booking information and its related vehicle information, collects the feedbacks, tracking the booking orders, new vehicle rates and deals and the vehicles servicing and maintenance information. The management staffs will handle the following tasks: operational staff handling, approving the new vehicles, staff's authorization, performance report and company report generation, updates the periodic deals and offers and the company budget management. At times, each tasks will be conducted with the collaboration of the various stakeholders including the IT staff, operational and management staffs.

Question Category Type (Goal/Process/Task level):

Procedural Type:

Substantive Type:

Write the requirements gathered during the RE Exercise for the following Questions:

9. List the stated goals and objectives about the proposed system.
10. List the different stakeholders that have been identified.
11. List the different work processes in the organization.
12. List the different tasks that need to be carried out under Customer Service work process.

9. Sample Transcript – Experimental Group

Following is the transcript work done by one of the participants from the Experimental Group:

"Your Question: What is the goal of the proposed information system?

Answer: The goal of KMC car rental company is to have an integrated company-wide secure web-based car rental and management system. So that the company can efficiently manage the data across their various locations as well as from mobile devices.

Your Question: Why is the goal important?

Answer: The company goal is to have a web-based car rental system. The reason is to eliminate the current problems such as double booking vehicles, or renting vehicles that are dirty or have not been maintained. It will also help the company access and view the car rental and vehicles information, improve the customers and internal staff's services and satisfactions, and efficiently track the cars which will ultimately increase the company profits.

Your Question: What are the specific goals for each of the stakeholders?

Answer: KMC has different stakeholders: customers, operational staff and management staff. For the customers, the system should do the following: provide an interface to do the registration, view special offers, deals, and history, contact a helpline, use an online chat facility, provide customer feedback/opinions, reserve/book cars efficiently, as well as view different types of vehicles and their rates. Operational staff should be able to do the followings: manage and track vehicle inventory, perform efficient car bookings, vehicle maintenance, as well as generate and maintain various reports, and provide help to customers online. Management staff should be able to do the following: generate revenue and performance reports, as well as add, delete, and modify access for operational staff.

Your Question: What work processes are within each department?

Answer: The company has the current work processes : Operational Department has customer service and vehicles management processes. The Management department has the resource management and report management processes.

Your Question: What are the objectives of each process?

Answer: The objective of each process is to have an efficient customer service for the KMC car rental customers and an increase in the company profit. Each four processes should be able to operate efficiently, in orderly fashioned. With the help of the new web-based system that encompasses these processes, the customers will have the ability to access the company vehicle information their rates, periodic deals and offers that KMC offers and the company itself will have the ability to operate different departments effectively from any locations and from mobile devices more securely, accurately and quickly.

Your Question: What is involved in each process?

Answer: The company has four work processes: customer service, vehicles management, the resource management and report management. In the customer service process, following items are involved- tracking customer orders, browsing vehicle information, reserving and booking vehicles, browsing periodic offers and deals, helpline over the phone, collecting hand written feedbacks from the customers, managing and viewing previous history, and registering.

The vehicle management process includes the management of the vehicle inventory, tracking rental rates, vehicle servicing, cleaning and maintenance. For resource management process, the following items are involved: managing staff, maintaining staff performance reports.

And the report management process includes: company revenue report generation, approving vehicle information, managing user authorization, staff

performance report generation, company offers, deals and coupons preparation and company budget management.

Your Question: What is the role of each process in the company?

Answer: The operational staffs and the management team of the KMC car rental company want to have an efficient way to coordinate the vehicle renting system, and the quick retrieval of the information across the multiple locations and on mobile devices. The role of customer service process would be to have an efficient and smooth customer service. The vehicle management process role would be to effectively manage the different activities for the fleet of vehicles in timely and orderly manner. The resource management process role would be to manage the various resources effectually and accurately and easiness of the operation. And the role of the report management process is to efficiently generate the reports to gain a company profit.

Your Question: What are the challenges for each process?

Answer: The biggest challenge is the migration from paper-based system to a new online based system.

Your Question: What are the factors that currently impede a person from being able to perform each process?

Answer: Currently there is simply too much data to manage. The large amount of data causes many errors in tracking vehicles, data storage and quick retrieval, time-consuming report generation, as well as data redundancy and loss.

Your Question: What tasks need to be performed in each process?

Answer: For the customer service process the tasks are: tracking customer orders, browsing vehicle information, its periodic offers and deals, taking the reservations, registering the customers, handling feedback, and managing and viewing previous history. The vehicle management process includes the following tasks: stores information about vehicles, managing inventory, tracking rental rates, vehicle servicing, cleaning and

maintenance. The resource management process handles the management of the operational staffs, approving new vehicle information, managing staff's authorization, and company budget management. The report management process includes the tasks of company report generation, performance report generation for operational staff and manages the periodic deals and offers.

Your Question: What are the possible challenges of each task?

Answer: The possible challenges will be to coordinate and merge the previous and new information related to the existing customers, vehicles and the organization accurately and in timely manner. It is also necessary to keep track of the internal and external data, its isolation, linkage and easy accessibility for the stakeholders.

Your Question: What are the objectives of the tasks in each process?

Answer: The company has the current work processes: Operational Department has customer service and vehicles management processes. The Management department has the resource management and report management processes. The objective of customer service process is to make sure only the internal customer and vehicle data are being processed accurately and can able to differentiate between internal and external data.

The objective of the resource management process is to make easy management of the staffs and their accessibility and authorization.

The objective of the vehicle management process is to have the easy retrieval of information of the fleet of vehicles, easy management of the inventory and car servicing information, and vehicle's rates and offers.

The objective of the report management process is to generate correct reports for both the company and the staff's performance and accurately generating the deals and offers the company wants to make."

Grading Table

Grading Criteria	Details	Comment	Grades
Questions Depth (4)	At least 12 questions practiced	yes	4
Questions Breadth (6)	Three levels covered each worth of 2 points	yes	6
Goal Level -2 Process Level -2 Task Level -2			
Prompts(4)	No. of substantive and procedural prompts attempted	yes	4
Question Structuredness(6)	Practiced questions in sequence: first goal, then process and lastly task level	yes	6
Questions Sequence (4)	order of questions: first substantive, then procedural	yes	4
Total (24)			**24**

10. Sample Transcript – Control Group

Following is the transcript work done by one of the participants from the Control Group:

"1. What database systems would you like? (Excel or Access?)

2. What web-hosting do you have in mind?

3. Would you also like a mobile app?

4. Would you like to use a VPN for internal users?(offsite access and added security?)

5. What are your specific locations, GPS/Map locations features?

6. GPS system to track vehicles?

7. How will special offers be delivered? Email?

8. Only positive feedback? Is this filtered through staff or posted in real-time?

9. Details of maintenance, revenue/staff report?

10. What FAQ questions? Will those be generated over time?

11. What types of security features/encryption are required?

12. What templates do you want me to use?"

Grading Table

Grading Criteria	Details	Comment	Grades
Questions Depth (4)	At least 12 questions practiced	Yes	4
Questions Breadth (6)	Three levels covered each worth of 2 points	Not really	0
Goal (2) Process (2) & Task (2)		-Some of the questions did not start with proper interrogatory questions. -questions asked were not in level as they should be. -questions were mostly related to IT.	
Prompts(4)	No. of substantive and procedural prompts attempted	no	0
Question Structuredness(6)	Practiced questions in sequence: first goal, then process and lastly task level	no	0
Questions Sequence (4)	order of questions: first substantive, then procedural	no	0
Total (24)			**4**

APPENDIX D

1. Institutional Review Board (IRB) Document

TOWSON UNIVERSITY

EXEMPTION NUMBER: 15-X062

To: Atiya Afsana
From: Institutional Review Board for the Protection of Human Subjects, Devon Dobrosielski, Member VS
Date: Wednesday, March 11, 2015
RE: Application for Approval of Research Involving the Use of Human Participants

Office of Sponsored Programs
& Research

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2236
f. 410 704-4494

Thank you for submitting an application for approval of the research *Preparing Industry-Ready Analysts In Classroom: A Module Injection Based Approach*

to the Institutional Review Board for the Protection of Human Participants (IRB) at Towson University.

Your research is exempt from general Human Participants requirements according to 45 CFR 46.101(b)(1). No further review of this project is required from year to year provided it does not deviate from the submitted research design.

If you substantially change your research project or your survey instrument, please notify the Board immediately.

We wish you every success in your research project.

CC: S. Chakraborty
File

APPENDIX E

1. Curriculum Vita

Name: Atiya Afsana

[redacted]

Academic Credentials:

- Doctoral of Science in Computer Information System, (2017) Towson University, Maryland
- Masters of Science in Applied Information Technology, (2008) (Concentration: Information Security Assurance), Towson University, Maryland
- Bachelor of Science in Computer Science, (2005) Independent University of Bangladesh (IUB), Bangladesh

Professional Publications:

1. **Atiya Afsana**, Suranjan Chakraborty, Siddharth Kaza and Suthirtha Chatterjee. (2015) "Preparing Industry-ready Analysts In the Classroom: A Module Injection Approach", Americas Conference on Information Systems (AMCIS) *August 13-15,* Puerto Rico.
2. **Atiya Afsana,** Yeong-Tae Song and Yongik Yoon. (2012) "Learner Profile Management in a Smart Learning Management Environment", *IV. International Future-Learning Conference on Innovations in Learning for the Future 2012: E-Learning Nov 14-16,* Istanbul, Turkey.
3. Yeong-Tae Song, Kris Glassmire, **Atiya Afsana** and Yongik Yoon. (2013) "Converged Learner Profile in MOOC environment", *ICMIA2013, 5th International Conference on Data Mining and Intelligent Information Technology, June 18 - 20,* Jeju Island, Republic of Korea.
4. Raza Hasan and **Atiya Afsana.** (2012) "Formation of Individual Heuristics for Software Maintenance Projects in Small Organizations", *Decision Sciences Institutes (DSI),* San Francisco, USA.

Certifications:

- CompTIA Security+
- CompTIA Network+

Research Interests:

- IS pedagogy and curriculum development
- E-learning
- Learning Management Systems
- Experiential Learning
- Requirements Engineering
- Information Technology

Teaching Interests:

- Computer Networking
- Computer Security
- Database
- Data Communications and Networking
- Requirements Engineering
- Introductory Programming

Teaching Experience:

1. ***Adjunct Faculty*, Computer & Information Sciences, Towson University *August 2008 – December 2015***

- Teaching Computer Science courses (both in –class and online).
- Supervising Labs.
- Preparing the lectures, assignments, labs and exams.
- Grading the exams and assignments.
- Advising students.
- Conducting research.

Industry Experience:

1. ***Information Technology Officer*, Standard Chartered Bank, Bangladesh *February 2005 - February 2006***

   Responsibilities included vendor management, and inventory control. Worked with vendors to resolve hardware and software issues; Tracked all IT inventories, and prepared procurement documentation; Managed small IT projects; resolved application problems, documented bank's administrative requirements; Produced MIS project update reports for senior management; Coordinated user support activities.

   Major Accomplishments:

   Desktop Computing Renewal Project: Developed project status report and documentation. American Express Bank Integration Project: Maintained documents of the inventories, project related to IT.

2. ***Library Assistant,* Independent University, Bangladesh *March 2006 – November 2006***

   Responsibilities included circulating library resources; performing data entry; and providing advice related to library matters. Provided assistance with searching information database CDS/ISIS (Computerized Documentation Service/Integrated Set of Information Systems) (WINISIS version).

3. ***Student Employee*, Graduate Admissions & Record, Towson University, USA**
   May 2008 – August 2008

   - Advised students on applications and grades.
   - Handled and reviewed international applications and applicants.

4. ***Graduate and Research Assistant*, EEOL, Towson University, USA**
   January 2007 –May 2008

   - Maintained IT lab systems. Provided technical support related to OS and applications.
   - Developed and maintained Extended Education Online Learning web pages.
   - Helped PhD candidates with research initiatives using Statistical Package for the Social Sciences (SPSS).
   - Performed data entry on the **I**nter**L**ibrary **L**oan **I**nternet **A**ccessible **D**atabase (ILLIAD).

References

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