

# Teaching Requirements Elicitation Interviews: an Empirical Study of Learning from Mistakes

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## Abstract

[Context] Interviews are the most widely used elicitation technique in requirements engineering (RE). However, conducting a requirements elicitation interview is challenging. The mistakes made in design or conduct of the interviews can create problems in the later stages of requirements analysis. Empirical evidence about effective pedagogical approaches for training novices on conducting requirements elicitation interviews is scarce.

[Objectives] In this paper we present a novel pedagogical approach for training student analysts in the art of elicitation interviews. Our study is conducted in two parts: first, we perform an observational study of interviews performed by novices, and we present a classification of the most common mistakes made; second, we utilise this list of mistakes and monitor the students' progress in three set of interviews to discover the individual areas for improvement.

[Research Method] We conducted an empirical study involving role-playing and authentic assessment in two semesters on two different cohorts of students. In first semester, we had 110 students, teamed up in 28 groups, to conduct three interviews with stakeholders. We qualitatively analysed the data to identify and classify the mistakes made from their first interview only. In the second semester we had 138 students in 34 groups and we monitored and analysed their progress in all three interview by utilising the list of mistakes from the first study.

[Results] First, we identified 34 unique mistakes classified into 7 high level themes, namely question formulation, question omission, interview order, communication skills, analyst behaviour, customer interaction, teamwork and planning. In the second study, we discovered that the student struggled mostly in the areas of question formulation, question omission and interview order, and did not manage to improve their skills throughout the three interviews.

[Conclusions/contribution] Our study presents a novel and repeatable pedagogical design and our findings extend the body of knowledge aimed at RE education and training by providing an empirically grounded categorisation of mistakes made by novices. We offer an analysis of the main pain points in which instructors should pay more attention during their design and training.

Keywords: Requirements Engineering Education and Training, Requirements Elicitation, Interviews

## 1. Introduction

Interview techniques have been used in a variety of fields, such as journalism, psychology, criminal justice and anthropology, to learn about the conscious or tacit ideas, concepts and knowledge that people carry inside their minds on any phenomenon [1]. An interview is a communicative event in which an interviewer asks questions to reach to the reality of a phenomenon conceived inside the mind of the interviewee.

Requirements elicitation aims at learning and discovering the needs of the stakeholders of the system [2] and still remains a challenging and problematic area in requirements engineering (RE) [3]. Requirements elicitation is challenging as this phase of RE explores the boundaries of knowledge, the people who possess this knowledge and how to acquire (and organise) that knowledge [3]. The information gathered during requirements elicitation needs to be correct, complete and unambiguous. In RE, interviews have been the most widely used elicitation technique, and are considered among the most effective in terms of information acquisition [4, 5].

In RE Education and Training (REET), the effectiveness of analysts in conducting requirements elicitation interviews highly depends on having experienced and actively participated in real interviews [6]. However, empirical evidence has shown that the methodological soundness and correct conduct of interviews is also important [4]. Therefore, in principle, both novice and experienced analysts can elicit high-quality requirements when the interview is well-planned. Mistakes made during design and execution of the interview tasks can impact the resulting software and system requirements [7].

An important part of training students on how to plan and perform elicitation interviews is to teach them how to prepare for the interview (e.g. by composing the right questions, making rapport with the interviewee, etc.). Another essential element of training is to bring awareness about the mistakes often made by novice analysts during these interviews. Students can learn from their mistakes based on the feedback provided by the trainers and improve their skills by practice. Feedback-based pedagogical approaches have been applied effectively in various other disciplines for teaching [8, 9].

Research has demonstrated the effectiveness of role-playing pedagogical approaches in REET by providing authentic assessment for the students [10, 11]. The educational approaches designed with authentic assessment require the educator to simulate the real world environment aimed at student learning by practice [12]. Mistakes, if observed explicitly during practice (even in simulation), can become a learning resource for students in the form of feedback. Furthermore, a comprehensive catalogue of mistakes made during elicitation interviews can be utilized in REET courses to help students better prepare for their role-playing activities.

In this paper we present the results from our empirical research comprising of two studies. The first study aimed to identify the mistakes made by student analysts during their role-playing in their first requirements elicitation interviews. The participants of the first study were 110 Master of Information Technology students enrolled in “Enterprise Business Requirements” course at the University of Technology Sydney in 2017. They were teamed up in 28 groups to conduct requirements elicitation interviews with a business owner (role played by an experienced academic). To identify the mistakes, the interviews were audio recorded and the recordings were reviewed by an experienced researcher and a professional business analyst. Furthermore, observation notes

were also taken by another researcher during the interviews. Reviews and observation notes were qualitatively analyzed to identify the themes and to classify all the mistakes. The result of this activity was a list of 34 mistakes made by the students, grouped into 7 high-level themes.

In the second study, the list of documented mistakes from the first study was used to evaluate the frequency of the mistakes across three subsequent interviews made by the students. The participants in the second study were 138 Master of Information Technology students enrolled in the same course in 2018 at University of Technology Sydney. We selected 9 groups from 34 groups of the cohorts of this class for this study, and we analysed 27 interviews in total (three for each group). The goal of this study was to better understand whether the learning approach followed is effective for improving the skills of the students. More specifically, we were interested to understand the occurrence of the different mistakes, and whether the students are able to improve their skills from the first to the last interview. The results of this second study showed that overall students did not improve throughout the different interview stages, and tended to repeat the same mistakes, such as not performing a summary at the end of the interview, not following a coherent order of questions, not prioritising the system features, and not building rapport with the customer. This suggests that more focused training strategies are required to let the students improve their skills already in the first interviews.

This paper is the extension of our previous work presented at the International Requirements Engineering Conference (RE 2018) in Banff, Canada [13]. Our research builds upon the Requirements Engineering Education and Training body of knowledge with the following contributions:

- We have identified a list of 34 unique mistakes made in elicitation interviews by novices that are classified into 7 high level themes. We provide contextual information and indicative recommendations, to assist the educationists and trainers for teaching the art of elicitation interviews.
- In the second study we demonstrate that the list of mistakes can be used as an effective instrument for analysing and assessing the progress of students in learning the elicitation interview process and identifying their weaknesses in specific areas.
- Our rigorous research design is a novel combination of several well-known pedagogical approaches that we used to conduct this observational study, such as role-playing, corrective feedback learning, and authentic assessment. This pedagogical design has been described in sufficient details to make it repeatable for future REET research.

The paper is organized as following: section 2 summarizes the background and related research work available on interviews. Section 3 highlights our motivation. Section 4 discusses our pedagogical design of the subject and section 5 gives details of the steps of research design and results. Section 6 discusses the implications of the research. Section 7 states the threat to validity and section 8 provides conclusion and future works.

## **2. Background and Related work**

Requirements elicitation interviews are recognized as one of the most effective and used techniques to elicit requirements [4]. Nevertheless, only a small part of the effort of RE community has been focused on studying the art of interviews in its depth as a knowledge acquisition tool and, more in general, elicitation technique [14]. There isn't much research focus on providing guidance to RE

educators regarding effective pedagogical approaches on teaching students how to conduct elicitation interviews.

## 2.1 Interviews

Most of the existing work on interviews focuses on identifying the variables that affect the success of an interview. In particular, the influence of domain knowledge [15-18], and cognitive strategies [19] were evaluated, as well as the combination of other individual factors, such as the expressive ability of the customer, and the absorptive capacity of the analyst. In the study of Distanont et al. [20], the variables that affect interviews have been categorized in three main classes: human-oriented, process-oriented, and context-oriented factors. For some of the analyzed factors, both positive impact and a negative impact have been identified. Two examples of these factors are: 1) domain knowledge [16], which, on one side, can help to prepare better questions and use a more appropriate language, and, on the other, might convince the analyst that she knows the answers better than the customer; 2) ambiguity [21], which is usually perceived as an obstacle to knowledge transfer, but, once identified in interviews, can lead to disclose tacit knowledge.

Another relevant factor for the success of interviews is the adequacy of communication. In this context, through a theoretical study, Coughlan and Macredie [22] identified articulation, misunderstanding, and conflict as the general classes of problems that hamper communication during requirements elicitation. Through empirical studies, (e.g., by Agarwal and Tanniru [23] and Browne and Rogich [24]), possible structures and models for the communication during interviews have been identified with the goal of improving the effectiveness in collecting requirements. Other works went a step forward and looked at how to improve communication in interviews through precise guidelines. For example, Pitts and Browne [7] showed that using procedural prompts that stimulate cognition, instead of interrogatories ones, lead to more successful interviews. Shuraida and Barki [25] showed that analysts who encourage the use of concrete examples are more likely to produce satisfactory requirements. From a practitioner's perspective, Portugal's work [26] provides a large set of guidelines, based on the author's experience, to conduct a successful interview.

## 2.2 Teaching interviews

None of the works mentioned in previous section, however, provide a set of guidelines of what to do and not to do in a requirements elicitation interview, or a comprehensive analysis of the most common mistakes of analysts, especially novices, who lacks experience and the needed skills, which, together with communication talent, are among the factors that mostly affect the quality of interviews [2, 16]. An initial work in this direction was published by Donati et al. [6], who identified and categorized nine mistakes that student analysts commonly make in interviews. The mistakes were derived from a thorough analysis of a set of student-performed interviews.

Besides this initial work, the literature does not offer any tool to effectively teach how to perform a successful interview, which should be one of the primary objectives of requirements engineering courses [11]. Unfortunately, because of the lack of tools and the lack of time this objective is often neglected. Indeed, computer science related degrees either offer only a course on RE, which should include all the different activities related to the discipline or, even worse, offer only a software engineering course in which at best, RE is relegated to a couple of lectures.

Given the lack of preparation of many analysts and the importance of this activity, many online trainings and courses have been created to help analysts to conduct more effective interviews. Lynda.com [27] offers a one and a half hour subscription training composed by 5 modules in which the main aspects of an interview are covered. The course also contains examples and challenges. Interviews are also taught as first-class citizen in subscription specialization online courses (e.g., [28, 29]) in which video-scenarios are provided to better contextualize the taught concepts. A training for interviews and workshops for IT projects is provided in a book form by Hathaway [30]; this training includes initial definitions, motivations, and some guidelines. Also, short variety of YouTube videos are provided to identify the main characteristics of requirements elicitation interviews and the most needed skills to succeed in them. However, none of these trainings and videos deepens in the analysis of the communication problems, systematically analyze all the most recurrent mistakes, and proposes solution for them. Most of them are only mainly based on the experience of the training developers.

Besides RE, interviews are important tools also in other disciplines, such as journalism, psychology, qualitative research methods, and criminal justice. In these fields, the analysis of interviews and the tools provided to teach them are in a much more mature state and have been developed through thorough research and deep analysis and experience. A large body of literature is available on how to conduct interviews in these fields and which common mistakes to avoid. In journalism, for examples, books such as [31], provide a practical, well-structured, easy-reference guide for journalists at any entry level: students, trainees and novices. It covers the analysis of interviewing techniques, the types of interviewees and how to read body-language. Since interviewing methods can differ depending on the goal of the interview, there are books specific to different products, such as the one of Martin [32], in which the author discusses interviewing methods for actuality documentaries, deeply analysing how they need to be run and prepared, and which situations to avoid. The field offers also books by the most expert journalists, such as for example Grobel [33], in which the readers can learn from the authors memorable experiences and analyses of them. It has to be noticed that journalism is an independent academic discipline with an autonomous degree [34] and this explains the abundance of material that targets young interviewers.

In social sciences, such as psychology, interviews are used as a double instrument, to collect qualitative data for research or to interact with patients. People interested in using them to collect data for research can refer to an extensive literature, which comprises both introductory works that define the different types of interviews and data collection methods (e.g., [35, 36]), more practical works that provides tips for running interviews (e.g., [37-39]), and books that generally contain both (e.g., [40, 41]). The tips-focused papers target either students [37] or inexperienced analysts [38, 39]. Among the other tips, Jacob and Furgerson [37] encourage students to go into an interview with a script that covers it from the beginning to the end. The script should consist of the reasoning behind the interview, explanations as to how the interview should progress, and a little introduction to build rapport between the interviewee and the analyst. This does not necessarily mean that the analyst cannot deviate from the script. In fact, it is encouraged that the student be willing to make 'on the spot' revisions to the interview protocol. The script should be used to guide the interview process, so details that need to be questioned or mentioned do not get missed in the conversation between the interviewer and the interviewee. This is in line with Diley's suggestion of working on an accurate protocol before walking in an interview [39].

On the practitioners' perspective, psychology, being taught as a university major as journalism, includes precise guidelines and provides tools for students and young practitioners to correctly run interviews. A comprehensive example of these guidelines is provided in [42], which is a manual on interviewing mental health patients based on objective research and best-practice principles. Other works in the field focus on giving recommendations, such as focusing on positive aspects while interviewing [43], or analysing strategies depending on the considered mental disease [44]. Interview techniques and skills are deeply studied also in criminal justice, where interviews are distinguished from interrogations, legal issues are faced, and different criteria are applied [45]. Besides traditional tools, trainings [46] are also available to cover the theory behind interviews and to practice through role-playing exercises.

The professionalism and quality of the results in conducting interviews in the above-mentioned fields suggest the need of producing similar guidelines, based on research, also in requirements engineering. Unfortunately, given the differences in goals and in the relationships with the interviewees with respect to these disciplines, new studies to deduce field-related guidelines are needed.

### 3. Motivation

The authors of this paper belong to five different academic institutions in Europe, United States and Australia. Our combined experiences of teaching RE courses in the last 2 decades both at undergraduate and postgraduate level has provided a rich tapestry of issues and challenges for REET. We have experimented with utilizing several pedagogical approaches to enhance and improve the learning outcomes.

Our motivation for this study comes from many years of observing how university students struggle to learn effective requirements elicitation interviewing techniques. Over the years, we have attempted to inform students on an *ad hoc* basis about possible mistakes that one can make in interviews. To do this task more efficiently, we have recognized a need to have an empirically validated list of possible mistakes and the corresponding examples to provide to students in a more formal manner. Therefore, one of the main aims of this observational study is to develop such a list and related examples to assist students in learning the skills of effective elicitation interviews. Furthermore, we believe that the list of mistakes is a very effective instrument for educators and trainers for monitoring students' progress when used in consecutive interviews.

Historically, our REET research began in 2003, when the second author introduced the authentic assessment environment through role-playing activity in stakeholder interviews [11]. Later, the Requirements Engineering Education and Training (REET) workshop was initiated in conjunction with the International RE conference in 2007 in order to generate awareness around the contextual pedagogical needs of RE students [12]. More recently, our first study [13] was inspired by our collective teaching experiences and partly triggered by a similar study by Donati et al. in REFSQ 2017 [6]. However, our study differs fundamentally from the work of Donati et al. in a number of different ways that we describe below. Many of these differences are informed by our previous experiences of teaching RE classes using role playing, as well as several self-identified limitations and some of the deficiencies we observed in [6]. Our first study [13] differs from [6] in the following ways:

- **Participants** – In our study we had 110 first year Master of IT students engaged in elicitation interviews as part of their first assessment task in their RE class. Donati et al, engaged 38 undergraduate students in their 3<sup>rd</sup> and 4<sup>th</sup> year in their “User Centered Design” course.
- **Role-playing** – In our study the role of customer was played by an experienced RE researcher and instructor who was also the tutor for this course; while in their case, half of the class played the role of customer and the other half the role of analyst. The decision for not using students to play customer role was based on the results of previous research [10, 11]. So, in our study, we had a single customer who was able to do consistent delivery of responses to questions in the interviews.
- **Case studies** – In the study by Donati et al, the customer participants were required to think about a “novel computer intensive system” for interviews, while our participants were divided into two and each half was given a different case study prepared by the instructor in the form of a one-page project brief to commence.
- **Preparation** – Donati et al prepared the analysts by a two-hour lecture on requirements elicitation interviews. Our participants were told to do the short course on requirements elicitation interviews on Lynda.com. They also attended an introductory lecture on requirements elicitation and more specifically on how to plan and prepare for interviews. In this lecture and the follow up tutorial, students were exposed to a number of common mistakes students make in their interview that included the list from Donati et al. Finally, we designed and created a few video recordings of good and bad interviews that was made available to students to help them in preparing for interviews.
- **Conduct of interviews** – Our interviews were semi-structured while theirs were unstructured. Their interviews were one on one, whereas our activity was designed for collaborative learning, hence a team of 3 or 4 group conducted the interview with one customer.
- **Interview output** – There was no written output required from the analysts after the interviews in Donati et al.’s study. In our study all the groups were asked to submit minutes of their interview for assessment.

## 4. Pedagogical Design

Software engineering (SE) discipline is required to produce industry-ready graduates. Therefore, the curricula need to prepare students not only with the current technical knowledge but also with self-learning and soft skills. Software Engineering educationists have been employing combination of ‘*learning theories*’ that have their roots in educational philosophies, most of which fall under constructivist paradigm of learning [47]. Some of the most widely used ‘*learning theories*’ by software engineering educators in their curricula design are ‘Learning by Doing’ [48], ‘Situated Learning’ [49], ‘Discovery Learning’ [50], ‘Learning through Failure’ [51], and ‘Learning through Reflection’ [52]. These learning theories provide the foundations of ‘problem-based’, ‘project-based’, ‘collaborative’ and ‘authentic’ learning. SE educators have been using these theories in designing curricula for more than two decades now e.g. ‘The Real World Lab’ [53], ‘The Software Factory’ [54] and ‘Software Engineering Studio’ [55].

Before the students reach their capstone project stage where they can be given a chance to face the real-world environment, they need to develop problem solving and social skills besides technical knowledge. Therefore, most of the SE and RE courses are designed based on problem-based learning and collaborative learning paradigms. Authentic assessment in collaborative learning paradigm

provides students with the simulation of real life challenges in which they have to focus on problem solving skills based on their previously gained knowledge and the management practices [56, 57]. In authentic assessment, students demonstrate their competencies of knowledge, skills and attitudes in a professional context [58]. The '*context*' is the base planned by the educators to provide the real world setting for learning outcomes and aims for the industry-readiness of the students [56]. The real challenge that SE and RE educators face is that of bringing the right balance of '*realism*' and the control of the classroom environment for the students in their curricula and assessments [59].

We used a combination of educational pedagogies in our study for the complex task of elicitation interviews in order to not only give the students an authentic experience of dealing with a customer, but also provide them the right guidance based on their mistakes and an opportunity to improve upon their mistakes. The interview task in our study was designed based on the guidelines of the following educational pedagogies:

- **Corrective Feedback Learning**

This paradigm advocates for using failures, mistakes or bad decisions as learning opportunities to improve in the future. In our study, we repeated the interview tasks three times over three weeks period, to give students time to reflect and prepare for the next round (Figure 1).

- **Role-Playing Activity**

In role-playing activities, we provided an environment for the student for rehearsing a real world problem-solving scenario for practicing certain skills. The students were to interview the business owners in a first interview and then other stakeholders in the second and third interviews (as they identified in their first interview).

- **Authentic Assessment**

Using the role-playing activity and case study-based learning we were replicating real-world challenges and standards of performance that experts or professionals typically face in the field. Some of the guidance were taken from the Dawson's [59] 20 tricks for creating authentic environment within classrooms, i.e. by providing ambiguous brief vision statement, challenges of dealing with customers, etc.

- **Collaborative Learning**

Authenticity requires the students to work on a problem within social context and dealing with other members of the group. In our activity we involved groups of students to work together on their case study, and prepare and conduct the interviews. This would not only challenge their problem-solving skills but also their social skills.

In Figure1 we present the overall pedagogical design of the requirements elicitation activities and the two assessments tasks that were the output from the interviews.



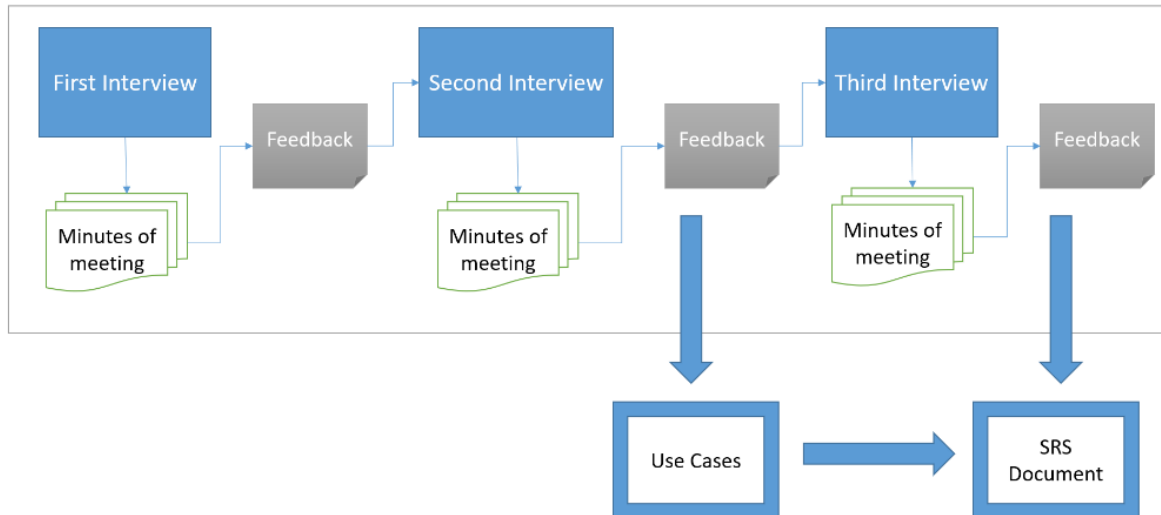


Fig. 1. Pedagogical design of interview activity

## 5. Research Design and Results

The work presented in this paper aims at studying mistakes made by student analysts in requirements elicitation interviews. To this end, we set-up an exploratory study aimed to answer the following research questions:

- RQ1: *Which are the categories of mistakes that student analysts make during their first interview?* This question aims at identifying general classes of mistakes showing occurrences of these mistakes in practice.
- RQ2: *How frequent are the categories of mistakes across subsequent interviews performed by student analysts?* This question aims at giving a numerical estimate for the occurrence of the different mistakes, and at understanding whether the students are able to improve their skills from the first to the last interview. The goal is to better understand whether the learning approach followed is effective for improving the skills of the students.

To answer RQ1, we perform our first study (**Study 1**), in which the pedagogical design described in Section 4 is applied. In this study, we identify the most common mistake categories by means of a set of reviews made by interview experts and a thematic analysis of the reviews. This study focuses on only the first interview performed by the students.

To answer RQ2 we perform a second study (**Study 2**), with the same pedagogical design, but a different cohort of students. Given the mistakes identified from Study 1, we define a questionnaire to allow interview experts to assess the occurrence of the identified mistakes in the interviews. To enable the analysis of the evolution of mistakes across interviews, we extend our analysis to all three interviews. The numerical results of the questionnaire are used to assess the frequency of the mistakes across interviews.

In the following sections we describe the two studies in terms of data collection, analysis and results.

## 5.1 Study 1

### 5.1.1 Study Context

The study was conducted in a university setting with master level students of Information Technology enrolled in “Enterprise Business Requirements” class. The first assessment task was for students to develop a complete software requirements specification (SRS) for a customer, based on a one-page project brief provided by the instructor (second author). The 110 students were grouped into 28 teams comprising of 3 to 4 members. Each team was instructed to conduct three interviews over three weeks with the stakeholders, to elicit the requirements. After the completion of each interview, students were required to submit the minutes of their meeting with the customer on a specially designed template within 2 days after the interview to capture what they have understood. It should be noted that the observations and analysis are entirely based only on the first interview. The first part of the deliverable was a set of use cases developed from the information elicited in the first two interviews. The final part of the assessment was a complete SRS using the IEEE standard template. The requirements elicitation interviews took place after students attended lectures on requirements elicitation and relevant techniques, attended a workshop for practicing interviews with customers. Students were also asked to watch the video courses on Lynda.com about “Requirements Elicitation for Business Analysts: Interviews” [27] and do all the exercises given. Two case studies were designed by the instructor and the class was divided into two, one half did the first case study while the other half tackled the second case study. Students were provided with the vision statements of the case studies for which they had to prepare an interview. The one page vision statement briefly described the current business process and the need for a new system. All groups were allocated 15 minutes for each of the three interviews with the customer of the case study they were assigned. Corrective feedback learning approach was adopted for the whole task. The aim of observing mistakes was not to assess the students for the quality of the interviews but to provide them feedback for the next round so they can improve their interview skills. The interviews were conducted as a role-playing activity with authentic assessment pedagogical setting [10, 11], in which we simulated a real world environment for the students to perform interviews with a customer. The task was collaborative in nature. The students were expected to plan for the interview as a group while various tasks were divided among members, such as preparing questions, asking questions, taking notes, audio recording interviews, preparing minutes of meeting.

### 5.1.2 Data Collection and Analysis

The research is exploratory and interpretive in nature and we used a qualitative approach to data collection and analysis. The second author was the instructor and coordinator of the course who designed the curriculum and delivered all the lectures. We had multiple Requirements Analysts; RAs (28 groups of students), a Customer; C (role played by the first author for all the groups, an academic and experienced RE researcher), an Observer; O (Third author, experienced RE researcher), and two Reviewers; R1 (Lecturer from another university; the fourth author), and R2 (a Business Analysts; the fifth author). The data was collected in three ways: audio recordings of the interviews, about 7 hours; the observation notes of the researcher (O), 4451 words; think aloud of the customer after every interview (C) in conversation with O (who took notes), 1635 words. The audio recordings were reviewed by two Researchers (R1, R2), and qualitatively analyzed independently for the mistakes the student analysts made in each interview, producing 4748 (R1) and 3546 words (R2). The use of “think aloud” was oriented to identify the mistakes perceived by the customer’s role during the

interview, which may be different, also in terms of perceived relevance (e.g., rapport with the customer), from those that could be observed externally. Overall, a total of 14,380 words (about 32 pages) of data was produced for further analysis. We had additional 28 documents of minutes of meetings submitted by all the groups after the interview. Figure 2 presents the overall method of data collection and analysis.

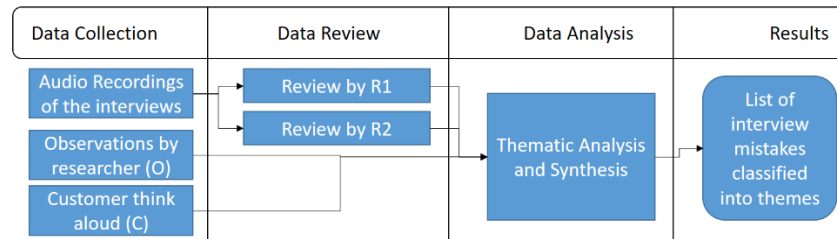


Fig. 2. Steps of data collection and analysis

Two of the researchers (First and Second authors), carried out the thematic analysis of all the data and synthesized the list of mistakes into classified themes. The four sources of data (two reviews, observation notes, and customer think aloud) were first stratified for individual groups for further analysis. Some mistakes were observed in all four sources of data, whereas there were cases of additional new and unique mistakes identified from the two reviews based on audio recordings. Our findings concur with [60, 61] that review of interview audio recordings provides more insights and reduces the bias of observations by triangulating the data from neutral perspective, as the reviewers are not being present at the time of interview. All the recorded mistakes were coded to identify the unique mistakes for each group and later analyzed for their frequency of occurrence in all groups. The mistakes were further classified into higher-level themes corresponding to the particular aspect of the interview. The final classified list of mistakes was peer reviewed by one researcher (third author). There were instances of disagreements related to the naming of themes and grouping, and they were resolved in discussion. After synthesizing and categorizing the list of mistakes, we reviewed the minutes of meetings submitted by all the groups. The aim was to investigate any plausible relationships between the types of mistake made during interviews and the extent of students' understanding based on what was recorded in the minutes. For this purpose, we had to go back and listen to some of the audio recordings again for further analysis.

### 5.1.3 Results from Study 1

In this section we present the results from our analysis and discuss the findings. We identified 34 unique mistakes classified into 7 higher-level categories of mistakes:

- Question Formulation
- Question Omission
- Order of Interview Questions
- Communication Skills
- Analyst Behaviour
- Customer Interaction
- Teamwork and Planning

Figure 3 shows the list of classified mistakes along with their frequency of occurrence observed in 28 groups. The most frequently observed mistakes are (1) asking vague questions, (2) incorrectly ending of interview and (3) not building rapport with the customer. We discuss these categories in the

following by providing examples from our qualitative data. Some of the examples may demonstrate more than one type of mistakes.

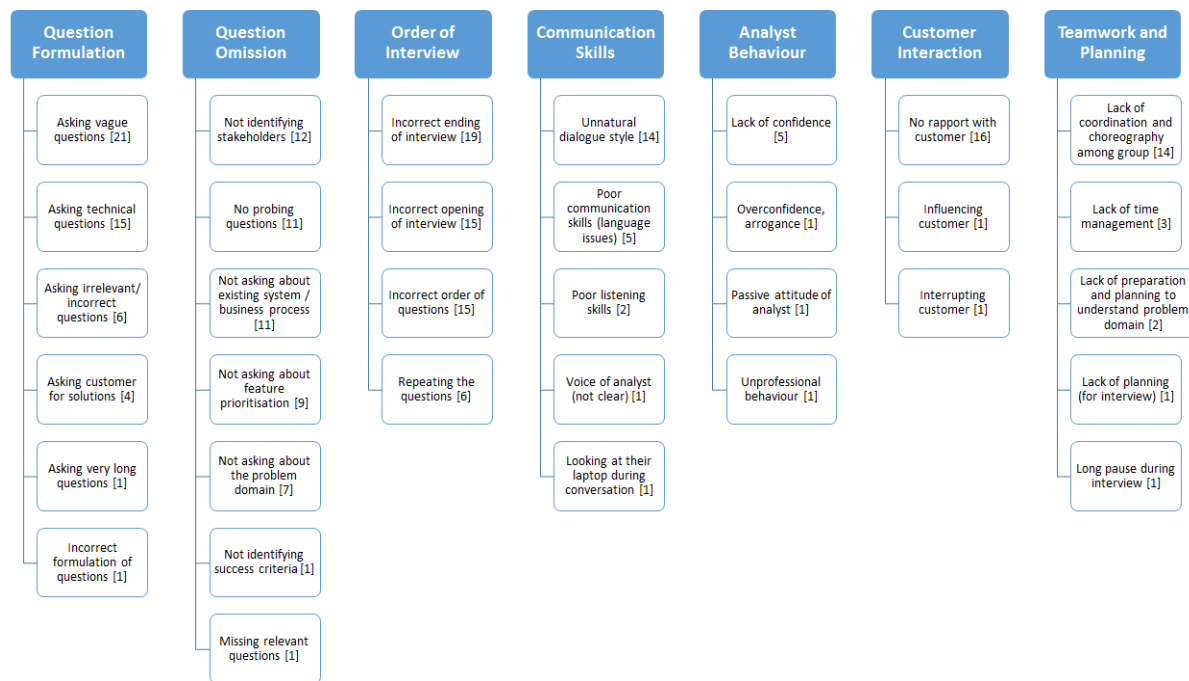


Fig. 3. Classification and frequency of interview mistakes

### Question Formulation

This category of mistakes refers to the problems and issues about the questions that student analysts asked the customer during their interviews. In a well-planned interview, the analysts have time in advance to prepare for writing down clear and unambiguous questions [6]. A response to the question depends on how the question is formulated. Vague, incorrect or unclear questions are rarely going to elicit correct responses from the customer.

The major mistakes observed in this category are: (1) asking vague questions, (2) asking technical questions, (3) asking irrelevant or incorrect questions, and (4) asking customer for solutions. We now give examples of the excerpts from the data used in the study. Some of these excerpts may also include the exact questions asked or statements made by the students in the interviews.

#### Asking vague questions

‘Asking vague questions’ was the most frequent mistake made by student analysts and was observed in 21 instances out of 28 interviews. We define vague questions in this context as the type of questions that may yield multiple interpretations, or cases where no reasonable meaning can be inferred from the questions asked. The ambiguities that can result from the response of the customer to a vague question can create further issues in later stages [62]. Asking these types of questions are hardly going to trigger the reasoning or stimulate follow-up discussion with the customer [24] and they indicate that the analyst is inexperienced in the art of question formulation [63].

#### Asking technical questions

Our data was collected from the first interview with a customer, who is in fact the project sponsor and business owner. The students were expected to have researched the customers' business context and prepare appropriate questions. Asking '*technical questions*' from the customer so early may not get an adequate response because it cannot be assumed that the business owner/project sponsor has detailed technical knowledge. Asking technical questions may also intimidate the customer and can lead to bad rapport.

#### *Asking irrelevant or incorrect questions*

This category refers to asking questions that are not relevant for the development of the system, or are inappropriate for the profile of the customer. Asking 'irrelevant or incorrect questions' will not only waste the time during interview session but also will add to the irrelevant data elicited during interview that might contribute to creating erroneous or redundant requirements. Asking these types of questions has been recognized as one of fundamental mistakes in requirements elicitation [64]. The other less frequent mistakes observed in this category were the students asked customer for "*solutions*", or asked a "*very long question*" that the customer has to ask for repeating or rephrase multiple times.

#### **Question Omission**

This category of mistakes refers to omitted questions that were expected to be asked by the student in the first interview. In this category the most frequent mistakes observed are when student analysts (1) did not ask to identify relevant stakeholders, (2) did not ask follow-up or probing questions, (3) did not inquire about existing system or business process, (4) did not ask the customer to prioritize the features and (5) did not ask about the problem domain. Missing these types of questions could potentially lead to missing requirements in later stages.

This exercise was the first stakeholder interview for the student analysts, and they were expected to find out the relevant people in the business and decide who they would interview next. Stakeholder identification is one of the important activity in requirements elicitation [65]. 12 out of 28 groups did not identify relevant stakeholders. A possible explanation for this mistake, as pointed out by [65], is that analysts mostly view stakeholder identification as a 'self-evident task', or they attempt to have less conflict of interests arising from the point of view of different stakeholders. Not asking probing and follow-up questions during the interview would fail the purpose of face-to-face communication, as interviews are reported to help analysts resolve the ambiguity that emerges during the interview [21], and to push the customer to express the tacit knowledge about the existing business process or system [66].

#### **Order of Interview Questions**

This theme refers to the mistakes about the overall order in which the questions were asked, i.e. the start of the interview, the order in which the questions are asked, and the ending of the interview. The order in which the questions are asked creates a flow of conversation that should lead in a logical way for customers to explain the project vision, and explain why they need a system within the existing business process. It was frequently observed that the student analysts did not make an attempt to have a good start and/or end to the interview but also asked the questions in incorrect logical order throughout the interview. The excerpts from the data showed multiple examples in which the students did not try to build rapport with the customer at the outset, they asked

questions about solutions before understanding the problem, and ended the interview abruptly without any final summary of the collected information.

It is necessary for the analysts to form a questioning strategy and include prompts based on the context of their interview, this can help in eliciting particular requirements as well as overcoming the challenge of customer-analyst interaction [24]. Prompting strategies can provide an opportunity for the analyst and user to re-evaluate acquired information. This should result in a more complete and more accurate set of requirements [7]. The recommended strategy to the student in this exercise was to: start the interview by building rapport with the customer, understand the existing business process, understand the problems faced by the customers in current process in order to reason on the need for a new system. Towards the end of the interview, summarize the findings to the customer to confirm the understanding. 19 out of 28 groups did not summarize the findings, and 15 groups did not open the interview correctly and asked questions in the wrong order. Summarizing the findings of the interview is a best practice for overcoming the misinterpretations during the interview [7] and overcoming any cognitive limitations during customer and analyst communication [24].

### **Communication Skills**

Interviews are a communicative intensive activity in which the analyst has to be involved in a face-to-face communication with people from diverse backgrounds, skills and knowledge levels [22]. In order to create a shared understanding with the customer during the interview, the communication skills of analysts are crucial. The analyst has to work on extra effort to remove the semantic gap and push the customer to the boundaries of their tacit knowledge. Effective communication has always been quite challenging for the analysts who are dealing with customers, and is one of the most recurring issues in requirements elicitation [67]. The data collected in our study in many cases pointed out that the dialogue with the customer was not considered as a natural conversation but more of a rehearsed sequence of asking questions like interrogation. This can make the customer uneasy. The use of common vocabulary during interview is also very important and the analysts should plan and prepare so that they will not use the words that might confuse the customer.

The difference between interviews and a survey questionnaire is that the former technique offers analysts the opportunity to have a face-to-face interaction to build an understanding with the customer by asking further questions based on the previous responses. But if the analyst is not carefully listening to the customer, or interrupts them in the middle of a response, or asks interrogatory questions, the benefits of face-to-face interviews get lost [6].

### **Analyst Behaviour**

The behaviour of analysts during interviews can impact on the attitude of the customers and influence their responses. Specially the overconfidence of the analyst can potentially lead to incorrect understanding of the problem domain and would prevent the analyst to look for alternative or contradictory information [7].

### **Customer Interaction**

As asserted previously, the successful outcomes of an interview activity relies heavily on the analyst-customer interaction [68]. It is typically the responsibility of the analyst to create a friendly environment that can stimulate the communication with customer [69, 70].

'Not to build rapport with the customer' at the outset of the interview was the third most observed mistake. 16 out of 28 groups made this mistake with the student analysts starting to ask direct questions from the customer straight away. This behaviour can intimidate the customer and can create an uneasy environment for the customer to properly express their ideas and vision to the analysts.

## Teamwork and Planning

In the context of this study, interviews were conducted as a group task, and there were instances in which the lack of planning and coordination among team members was easily observed. In some cases, the team did not have a planned choreography of task divisions for asking questions and taking notes, and the interviewers would interrupt each other. In other cases, they did not profit from the 15 minutes allocated for the task, and they either made long pauses, or ended the interview earlier.

## 5.2 Study 2

### 5.2.1 Study Context

Our second study was conducted on different cohort of master level students. They were given the same task as study 1 to prepare and conduct three stakeholder interviews in three weeks. There were 138 students and were grouped into 34 teams comprising of 3 to 4 members. Our second study differs from the first study in the following ways:

- The participants in this study are a different cohort of students from the first study.
- The role of customer for two case studies were played by two hired casual academics with no expertise in RE. None of the authors of this paper were involved in the interviews to mitigate potential researchers' bias. These individuals received basic instructions about their role-playing from the instructor on weekly basis.
- In this study, we recorded all three interviews for all groups. For analysis, we selected only 9 groups based on their assessment marks as described below.
- The results in study 2 are based on independent reviews of the audio files only, and we did not use customer think aloud or observations in our analysis (as was in Study 1).

### 5.2.2 Data Collection and Analysis

Although the pedagogical design of the task was the same, our research aims were different for this study. This time we were aiming to analyse all three interviews in order to explore the pattern of mistakes that would emerge. We selected 9 groups (from total of 34) based on their assessment performance of final submission of SRS, i.e. three highest mark achievers, three average and the three lowest. We had a sample of 27 audio files from these 9 selected groups. Three reviewers (third, fourth and fifth authors) were randomly assigned 18 audio recording each, without informing them of which interview they are listening to or which group they are reviewing. One audio file was reviewed by two reviewers independently. We used the list of mistakes from the first study and prepared an online survey form to enable reviewers to evaluate the interviews in a systematic manner and obtain quantitative results. The survey form was designed on 5-point Likert scale from *Strongly Disagree (score 5)* to *Strongly Agree (score 1)*, based on whether the reviewer observed the specific mistake in the audio recordings of the interview. The survey questions are listed in Appendix A.

Once all the reviewers filled the survey for their assigned audio files, for every audio file the average scores were calculated for every question of survey based on the answers of the two reviewers. Lower scores for a question indicate the presence of more mistakes whereas higher scores are indicator of better quality interview (based on less number of mistakes made). We analysed the data based on the group performance, the interview number and the category of mistakes. Figure 4 presents the whole data collection and analysis process for study 2. The results are discussed in the next section.

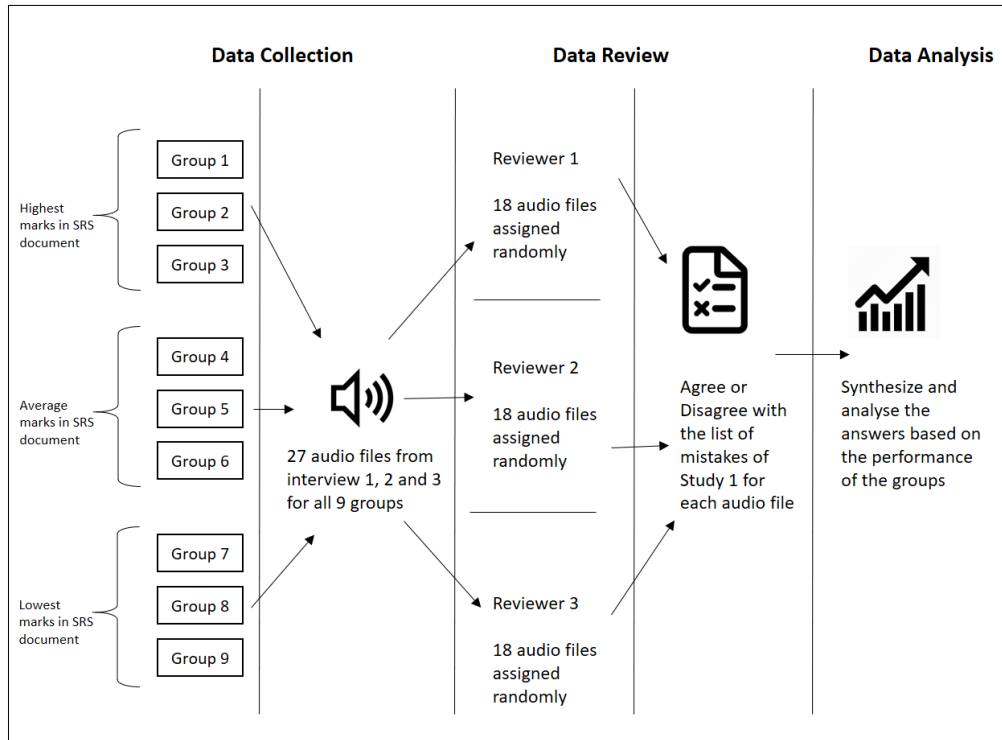


Fig. 4. Study 2 research design: data collection and analysis

### 5.2.3 Results from Study 2

Figure 5 shows the combined results from all 9 groups for all three interviews together. A clear pattern from the results could be observed that indicates all the groups struggled with ‘question formulation’, ‘question omission’ and ‘interview order’ in all three interviews. Although we selected 9 groups based on their assessment mark of final SRS documents, we were unable to find any significant or clear correlation between the performance during the interview (based on number of mistakes) and the quality of SRS document (assessment marks). The performance of the individual groups is shown by charts presented in Appendix B for all categories of interview mistakes. In this section we will discuss about the nature of mistakes rather than individual groups.



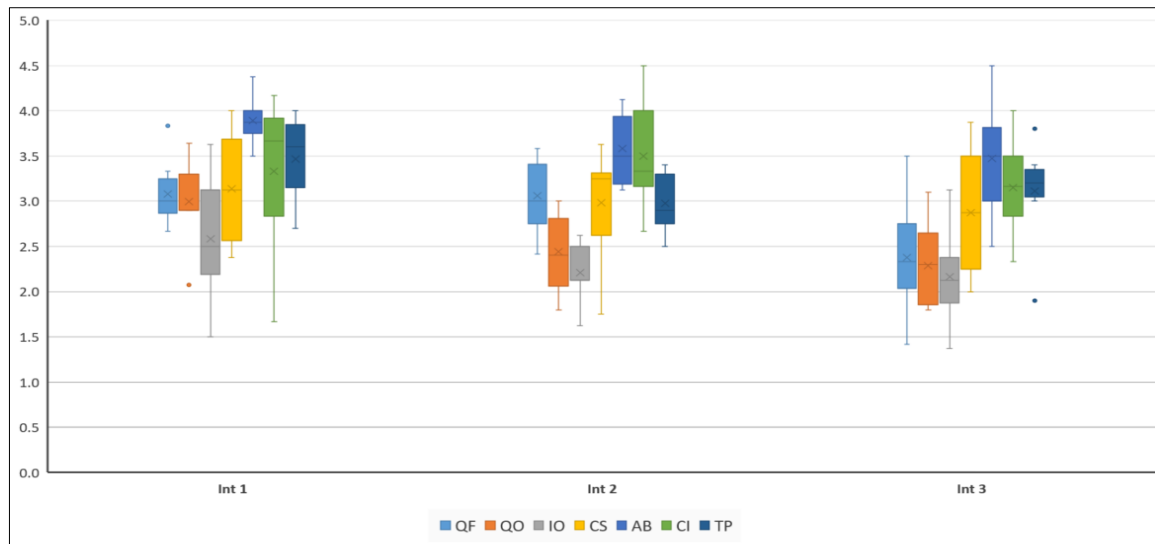


Fig. 5. Analyzing all groups for interview (int) 1, interview 2 and interview 3 (LEGEND QF: Question formulation, QF: Question Omission, IO: Interview Order, CS: Communication Skills, AB: Analyst Behavior, CI: Customer Interaction, TP: Teamwork and Planning)

We now unpack the results of all the categories of mistakes for all groups to gain a more explicit insight of the differences between each interview and each category of mistakes for all group. For each category of mistakes, we present two separate visualisations of the results:

- Overall performance of all groups on Likert scale 1 to 5 (1 means lowest performance – most mistakes made and 5 means highest performance – least mistakes made);
- Percentage of the frequency of individual category of mistakes made by all nine groups.

### Question Formulation

Based on figure 6, some of the groups seem to have struggled with the question formulation in the interviews. The overall average performance of all the groups did not improve from interview 1 to interview 3. Figure 7 shows the individual elements of the *Question Formulation* theme and shows the percentage of the frequency of mistakes made by 9 groups in each interview. Which again shows that the students did repeat or made more mistakes in question formulation.

For this observation from figure 6 and 7, we conjecture that the students had to prepare new sets of questions for every interview. For the first interview, the questions were more generic in nature (easily adopted from online resources without much modification). But in the second and third interview they were expected to ask more domain-specific questions based on the answers elicited in their first interview. This required an element of creativity that was not necessarily needed in the first interview. This is also evident from figure 7, as more groups start to make the mistake of *‘asking incorrect question’* or *‘asking irrelevant questions’* in subsequent interviews.

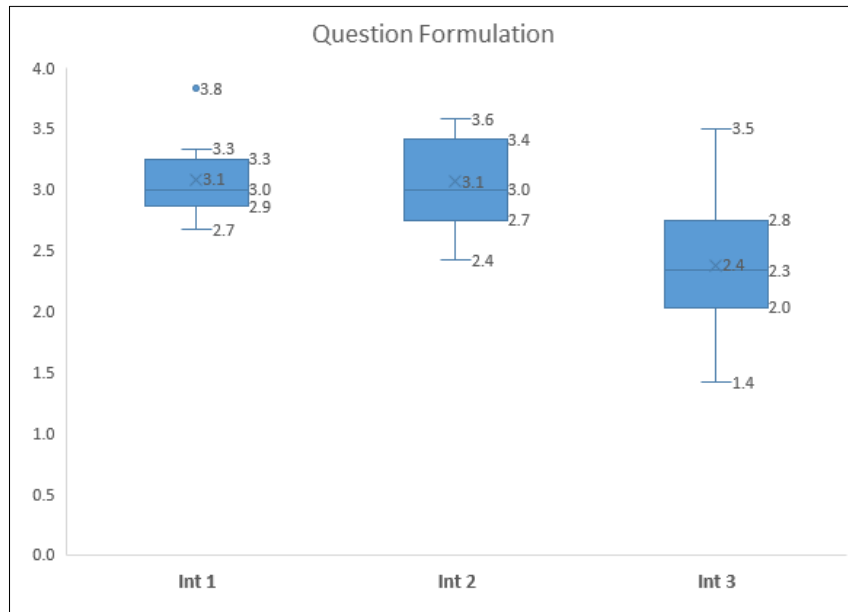


Fig. 6. Performance of all groups in Question Formulation

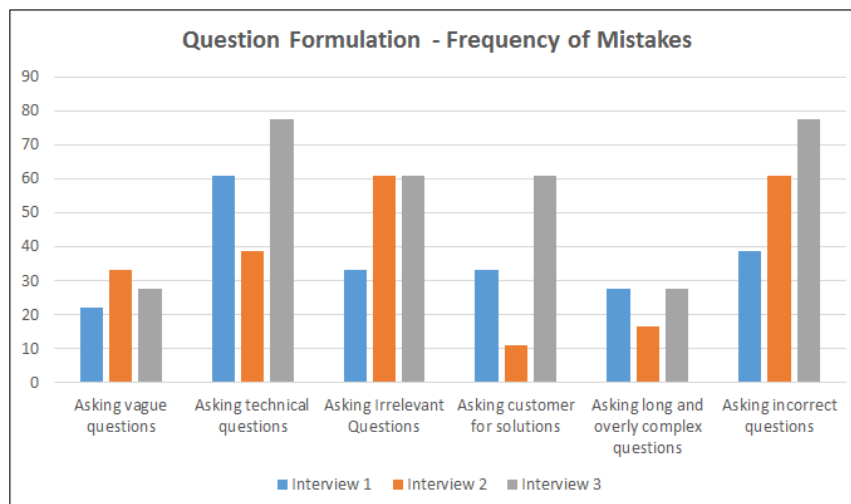


Fig. 7. Frequency of individual mistakes in Question Formulation

### Question Omission

In this category the performance of all the groups have suffered and the scores for all of them were reduced rather than improved by the third interview (see figure 8 and 9). One of the reasons may be that some relevant questions, (e.g. about business goals or success criteria of stakeholder), were already asked in previous interviews, and the students did not consider that different stakeholders may have different goals. Therefore, when confronted with potentially a different stakeholder in the second and third interview, they did not ask about their success criteria and expectations about the system, but focused solely on clarification questions or asking technical questions. Missing out on the opportunities for asking questions in different interviews is contextual just like previous category *Question Formulation*. The second and third round of interviews required a different kind of planning in comparison to the first interview and the students seem to be struggling to comprehend the differences.

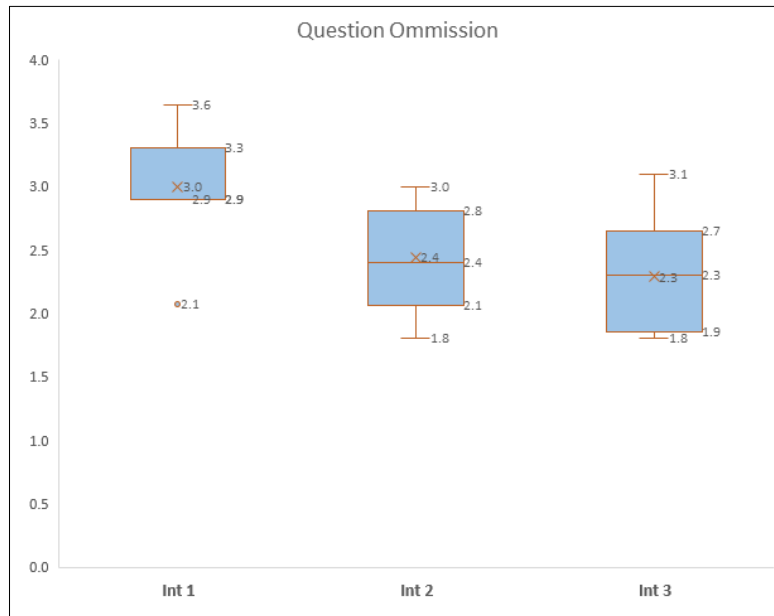


Fig. 8. Performance of all groups in Question Omission

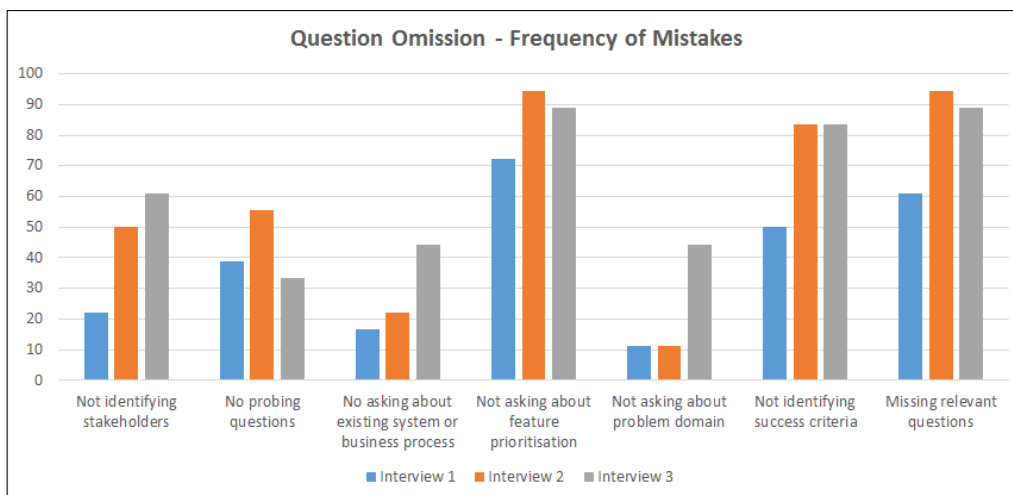


Fig. 9. Frequency of individual mistakes in Question Omission

### Order of Interview Questions

As we can see in figure 10, this aspect of elicitation interview has been a weak point for all groups throughout all the stages of interview. Specifically, as we see in figure 11, in majority of the cases, the students (a) did not provide a summary at the end of the interview, and (b) tended to perform the interview as a scattered list of unrelated questions, without creating a coherent knowledge elicitation flow, in which questions are connected to each other, and (c) they performed poorly in 'opening interview' in all three interviews. The last point may be due to the fact that the same tutor was playing the role of interviewee (even though not necessarily playing the role of the same stakeholder), and the students did not feel it necessary to build rapport with the same person playing role of a different stakeholder.

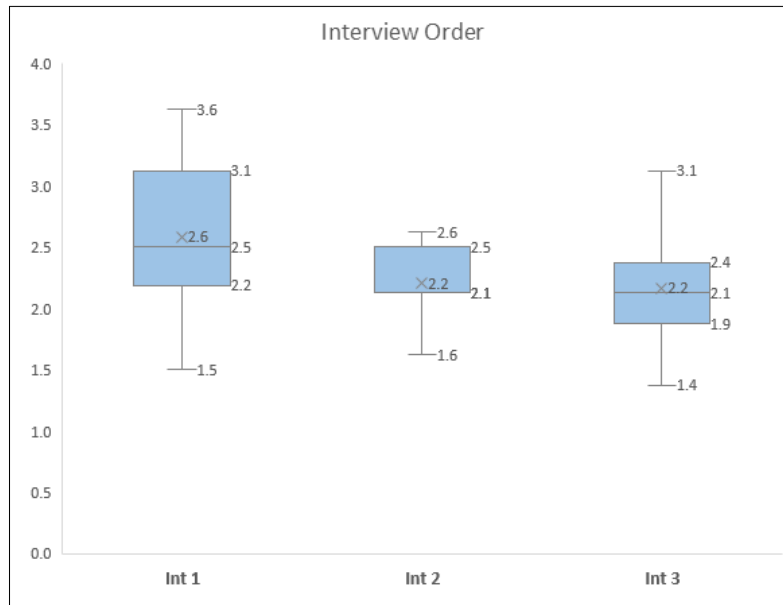


Fig. 10. Performance of all groups in Interview Order

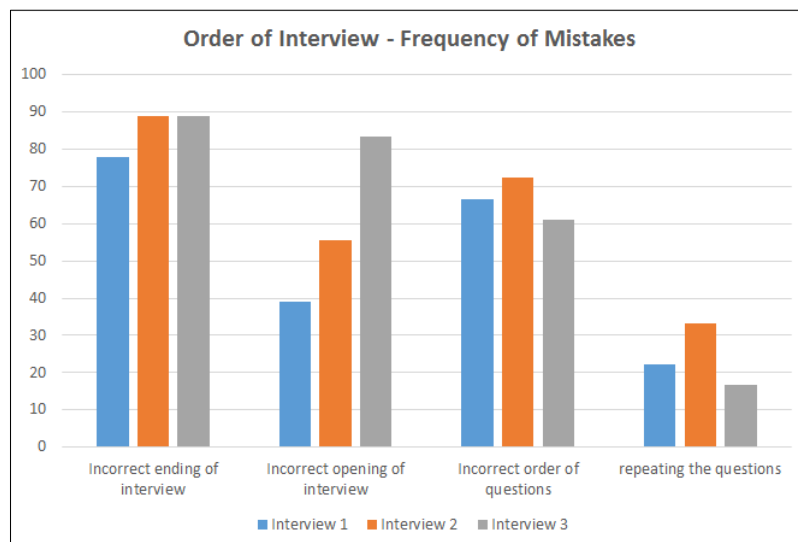


Fig. 11. Frequency of individual mistakes in Order of Interview

### Communication Skills

From figure 12, we can do not see a clear pattern of improvement in students' performance across three interviews in their *communication skills*. We had 4 types of mistakes for communication skills to analyse. Figure 13 shows that the *dialogue style* and the *listening skills* seem to show improvement in subsequent interviews. This may be due to the fact that the repeated activity and feedback helped them to improve these areas, which were related purely to their social skills rather than the domain of elicitation interviews. Another noteworthy point is that groups were advised by the instructor to switch roles in each of the three interviews. That is, they were told to allow all group members to have an opportunity to ask questions. This means that some groups may have selected one group member whose communication and language skills was the best among all members to ask all the questions in all interviews. On the other hand, some groups may have taken

the advice of the instructor and have rotated the responsibility of asking questions in the interviews in order to give a chance to all members to develop this skill.

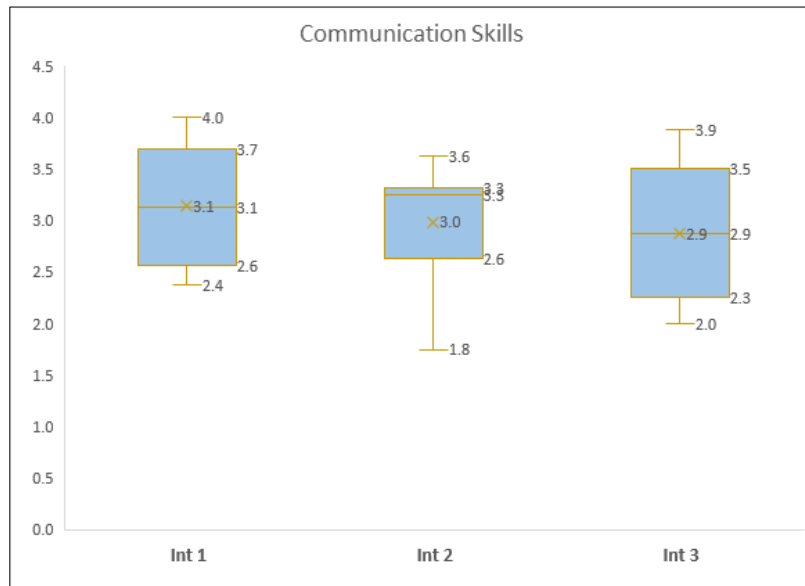


Fig. 12. Performance of all groups in Communication Skills

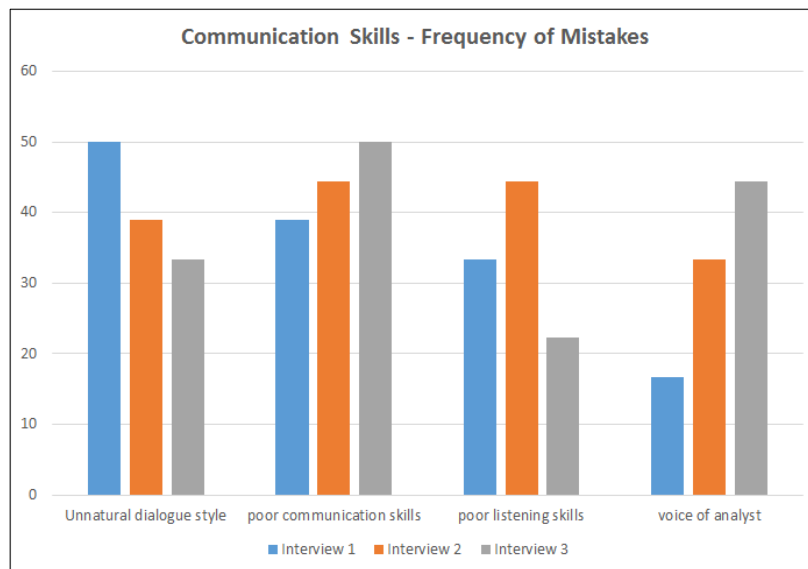


Fig. 13. Frequency of individual mistakes in Communication Skills

### Analyst Behaviour

From figure 14, this aspect of elicitation interviews has been an indicator of good performance for all the groups and remained somewhat consistent throughout three interviews. Furthermore, it should be noticed that, on average, the percentage of mistakes are less with respect to the previous categories (see figure 15). However, we would like to point out that in study 2, unlike study 1 we did not have an observer in the room at the time of interview or did not take notes from customer on the perception of interview. In study 2, the reviewers had access only to the audio recording of interviews, while the analyst behaviour may be better evaluated by considering also body language and general attitude that can often be evaluated through visual observation.

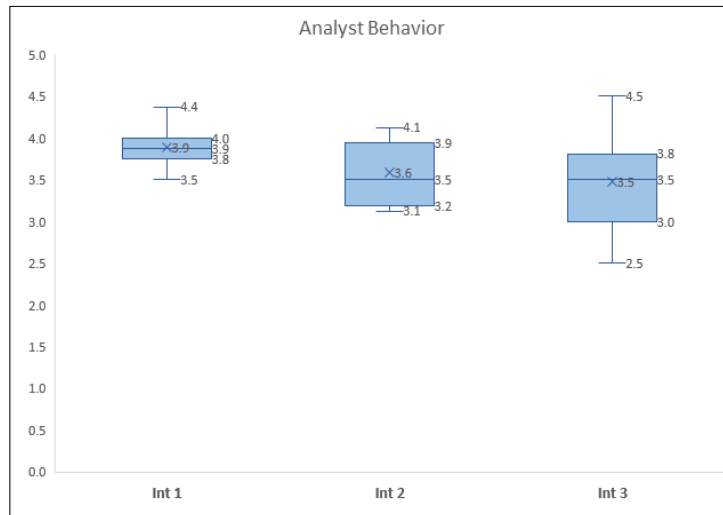


Fig. 14. Performance of all groups in Analyst Behavior

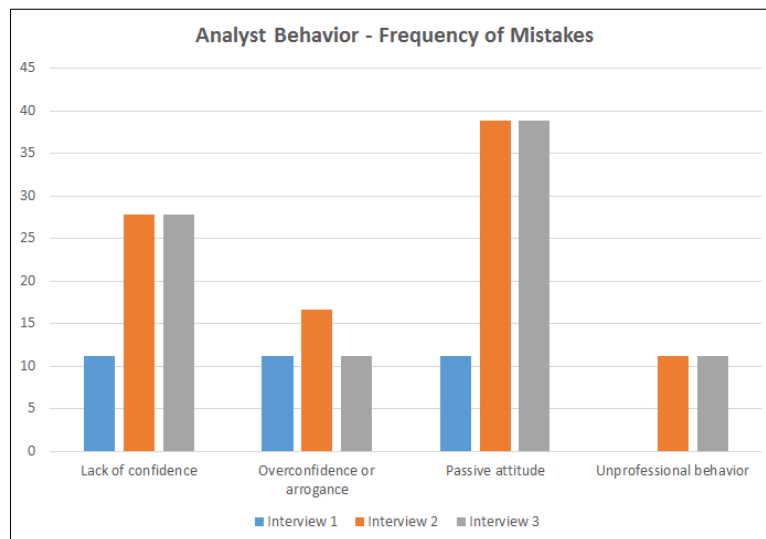


Fig. 15. Frequency of individual mistakes in Analyst Behavior

### Customer Interaction

Although figure 16 shows that, overall, some of the groups have shown improvement in their customer interaction towards the third interview. However, this category only had three elements and looking at figure 17, we see that majority of the groups had difficulty in building '*rappor*t with customer'. This particular mistake is strongly related to '*incorrect opening of interview*' in figure 11 where in interview 2 and 3 the students did not improve on their role-playing of analysts for different interview contexts.

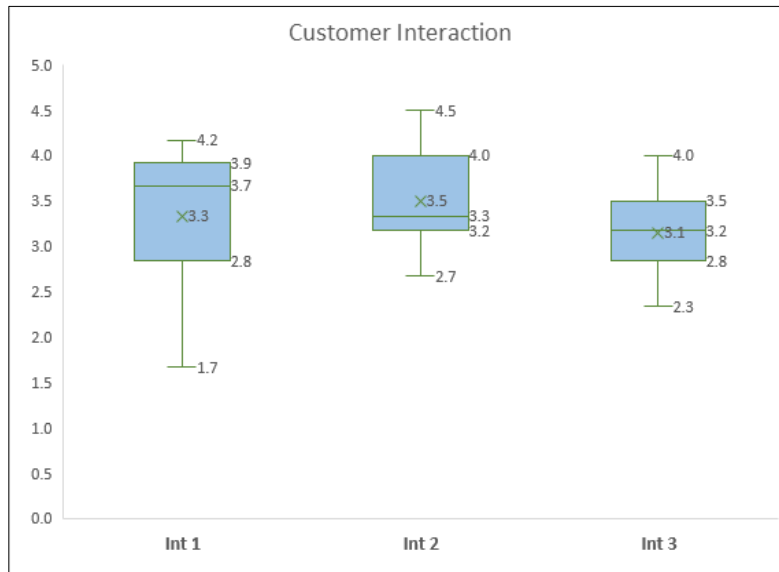


Fig. 16. Performance of all groups in Customer Interaction

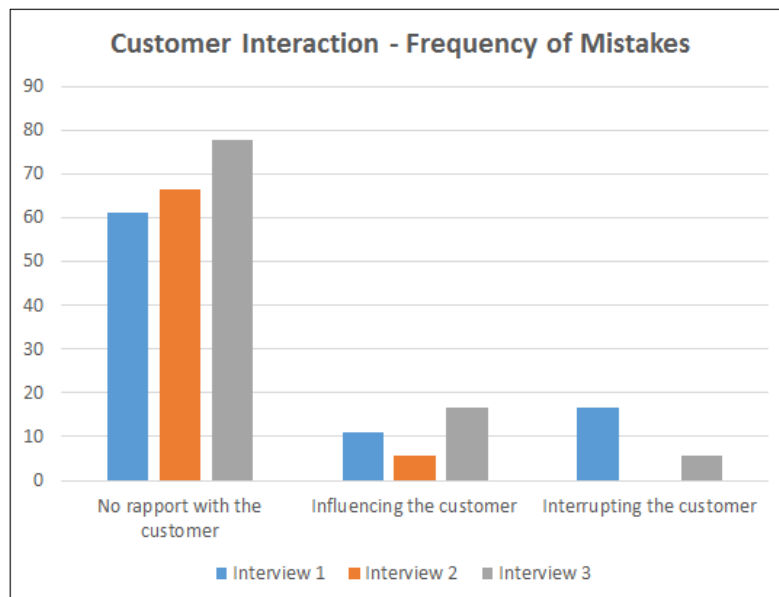


Fig. 17. Frequency of individual mistakes in Customer Interaction

### Teamwork and Planning

From figure 18 we observe that the students did not make any substantial improvements in their teamwork and planning towards second and third interview. Looking at the individual mistakes within this category, from figure 19 we can see that the only mistake type they significantly performed poorly was on their 'time management' aspect of the interview. The students were given 15 minutes for each interview, and we can see that they did not plan well for their 2nd and 3rd interview to prioritize and ask only the important and relevant questions. The 15 minutes limit for the interview time was due to large class and financial resources for teaching to pay for extra time of the casual academics who were playing the roles. Students were advised to rehearse their interview in order to better manage the timing of interview. There is a clear indication from verbal feedback given by groups to their tutors that not all of them took this advice.

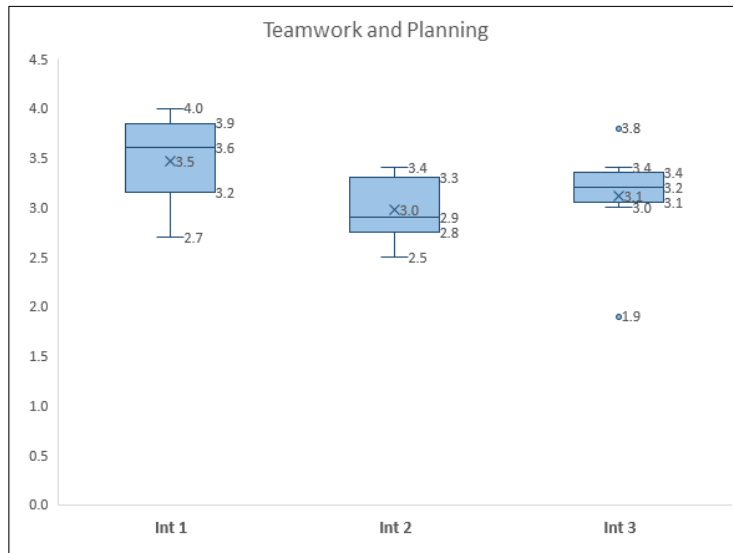


Fig. 18. Performance of all groups in Teamwork and Planning

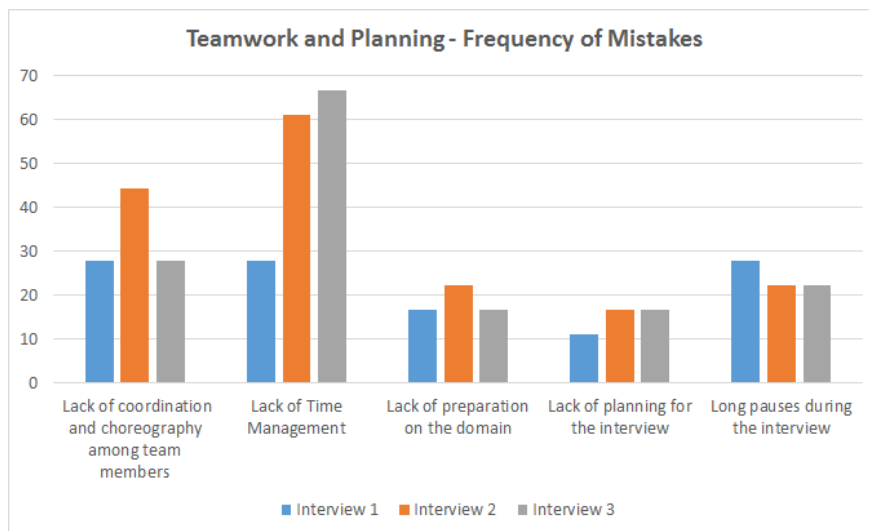


Fig. 19. Frequency of individual mistakes in Teamwork and Planning

## 6. Discussion

In this paper we have presented the results from two studies of analyzing the mistakes made by novice analysts (students) during their elicitation interviews with the stakeholders. In this section, we compare and contrast our findings with previous relevant research.

### 6.1 Domain knowledge

Effective requirements elicitation largely depends on the familiarity of the analyst with the problem domain [16, 17]. In our study, the students were provided project briefs for their case studies in order to do their research and planning for the interview. Requirement analysts can be more effective if they have developed a good understanding of the problem domain [15]. The domain knowledge helps the analyst in proper planning of the interview, in developing shared understanding with the customer, and gathering and organizing the acquired information into complete and clear requirements [7]. Looking at the mistakes observed, we argue that the lack of domain knowledge by the student analysts potentially contributed to several of the mistakes made in question formulation



or omissions. For example in our category of question formulation, the mistakes observed regarding the students asking incorrect or irrelevant questions (Figure 3, 6 and 7) were mostly due to lack of understanding of the problem domain. A well-planned interview can address this issue.

Previous research in RE suggests that lack of domain knowledge does not necessarily impact on the effectiveness of the interview [17, 18, 71]. This might be true in case of expert analysts who do not have to worry about the interview process and can formulate questions correctly based on their experience of interviewing. However, for novices and students, who are experiencing their first interviews with stakeholders, lack of domain knowledge does not help in improving interviewing skills and they end up asking wrong and irrelevant questions, hence collecting incorrect and incomplete requirements.

## 6.2 Minutes of Interviews

For instructors, it is important to assess the level and extent of students' ability to perform an effective interview. In order to achieve this goal, we asked students to write minutes of their interview immediately after the completion. The content of the minutes gives instructors a good indication of the level of students' understanding of the application domain and the initial requirements developed in their interview. In our studies, we observed that the students who performed well during their interview, also produced reasonably good quality minutes. However, there were also a few cases where the minutes were of poor quality even though the interview was assessed to be reasonable. So, it is not just enough to ask the right questions in the interview, but it is also equally important to listen carefully to the responses given by the customer and accurately record the understanding developed. This may be due to the fact that many groups did not present a summary of the interview discussion to the customer at the end of the interview i.e. '*incorrect ending of interview*' (See figure 3 and 7).

## 6.3 Rapport with Customer

Our results of both studies revealed that students struggled with their attempt to build rapport with customer (figure 3 and 17). Many of the cases where attempt was made to do so, especially in case of first interview, it seemed rather unnatural and essentially copied the utterances given in the Lynda.com online course that students accessed to prepare for the interviews. We assert that teaching students this particular skill is rather challenging as it does not come naturally to many and can also depend on culture and ethnic background of students. We recommend that students rehearse their interviews, and if possible, record it and try to improve it with practice before coming to the real interview. However, this is a skill that would ultimately only improve with practice in real settings.

## 6.4 Ambiguity as a Resource

The results of study 1 have revealed that 21 out of 28 groups have made the mistakes of asking vague questions (See figure 3). We observed that the responses to those questions in the minutes were also ambiguous. Since the design of our assessments were developed following the corrective feedback learning paradigm, we adopted the idea presented in [21] to use the ambiguity in the interviews as a learning resource for students in preparing follow-up questions for the next round of interviews. Although study 1 only focused on the observations made during first interview, we asked the students in study 2 to identify the ambiguous responses in their minutes to formulate questions for the next round of interviews. Our observations in study 2 of the questions asked in the follow up interviews,

reaffirmed our intuition that this approach was very effective, which resulted in students improving their understanding of the requirements and not *'asking vague questions'* (see figure 7). We recommend this resource to all instructors as an effective teaching tool.

One of the mistakes strictly related to leveraging ambiguity is the incorrect ending of interviews, i.e., the absence of a summary at the end of each interview. In past research [21] we have observed that a summary, performed by the analyst to confirm their understanding, can often trigger further clarifications from the customer's side.

## 6.5 Experience versus Planning

The systematic review of Davis et al. [4] has revealed that a novice analyst, with careful planning for the interview, can elicit information equally as well as an experience one. In our first study, one of the students already had experience of being business analyst and relied on his experience during the experiment rather than planning and coordinating with the group. That group made more mistakes due to his overconfidence and intimidating behaviour towards the customer. Giving customer an impression that the IT people know it all is a bad practice and impedes the formation of trusting relationship between the two sides which should be a critical aspect of the first interview.

## 6.6 Contribution to the Body of Knowledge

Our studies reported in this paper have generated new insights both in REET research as well as into the development of new pedagogical design for teaching interviews. We have developed a systematic empirical approach to study the mistakes that novice analysts make in their encounter with a customer during elicitation interviews. Our research design is substantially more rigorous than the only study of this kind previously published within the RE community [6]. Furthermore, by applying this research design in the curriculum development and performing two studies we have extended the number of the previously identified mistakes [6]. These new mistakes relate to group behavior and organization as well as attitude of the novice analysts. We have also presented the frequency of the mistakes. Besides the contribution of our study to the Body of REET Knowledge, we believe the findings are important to educationists and trainers in the following ways:

- We reaffirm that role playing [10, 11], is a very effective method of REET, in particular, requirements elicitation interviews.
- We have presented a curriculum design that utilizes a collaborative learning environment, which is considered as an effective pedagogical approach in RE.
- Through our second study by using the list of mistakes as checklist (survey), we have identified the areas of elicitation interviews that the educators and trainers need to focus more when teaching the novices.

We now revisit our research questions and provide answers from the results of the two studies.

### **RQ1: Which are the categories of mistakes that student analysts make during their first interview?**

There are in total 7 categories and 34 mistakes that we observed in our study 1 (Figure 3). The categories are on abstraction, related to either the domain-related aspect of elicitation interviews (i.e. Question Formulation, Question Omission, Interview Order) or social aspect of elicitation interview (i.e. Communication Skills, Analyst Behaviour, Customer Interaction, Teamwork and Planning).

### **RQ2: How frequent are the categories of mistakes across subsequent interviews performed by student analysts?**

The overall performance of students in both studies (from figure 3 and 5) indicates that they made more mistakes in domain-related categories (i.e. Question Formulation, Question Omission, Interview Order) in comparison to other categories (i.e. Communication Skills, Analyst Behaviour, Customer Interaction, Teamwork and Planning). Both studies reveal that students have struggled more in asking correct question, opening and ending of interview, and building rapport with customer throughout all the interviews. These are the pain points that the educators and trainers have to consider to train students better in these areas in comparison to others.

From the answer to our research questions, for educators and trainers who wish to prioritize the list of mistakes to ask students to focus on the important aspects only, we have the following suggestions:

- Remember to create rapport with the customer
- Remember to identify customers' goals and success criteria
- Be curious about the application domain of your customer
- Do not ask too many technical questions
- Ensure your questions are expressed in a correct manner, by rehearsing the interview
- Remember to prioritize the interview questions based on the context
- Make sure that all the relevant questions are covered, by preparing for the interview
- Make and present a summary of discussion at the end of the interview

## 7. Threats to Validity

Both our studies were conducted under interpretivist paradigm [72], which relies on the interpretation of the construct through the understanding of the researcher. In regards to the data analysis in this paradigm of inquiry, it is impossible to claim absolute exactness of the results free from researchers' bias. The researchers are expected to draw on their knowledge to produce insights from observations and build concepts from which their theory emerges.

### 7.1 Study 1

In study 1, we have tried to mitigate the risk of researcher's bias and increase the reliability of the results in our research design through independent reviews of researchers who had nothing to do with the course delivery and two of them were not even present during the interviews. One of the reviewers (4<sup>th</sup> author) is an instructor in another university and one (5<sup>th</sup> author) is a Business Analyst. With this in mind, we consider that we have provided sufficient details of the process of data collection and analysis in this paper to indicate the reliability and increase the trustworthiness of the results. R1, R2, O and C may have been biased by the knowledge of Donati et al [6], when looking for mistakes. Although we explicitly asked them to do their analysis without considering this previous work, this threat could not be entirely mitigated. However, the identification of 21 additional mistakes, shows that this threat was addressed in practice. The multiple role of customer, teaching assistant and researcher of the first author and instructor as well as researchers of second author are also possible sources of bias in the data analysis phase. This is mitigated by the presence of different, independent viewpoints in the different phases of the data collection and analysis process. The behaviour of the students, and therefore the commission of certain mistakes, may be influenced by the relation of the students with the teaching assistant, who was playing the role of customer. Different behaviours may be observed with real customers. Although this threat could not be fully

mitigated, it should be noticed that the teaching assistant had previous experience in role-playing, and this allowed her to play the customer's part with sufficient realism. This allowed a partial reduction of the confounding effect of the instructor-student relation. Furthermore, given the synchronous, human-intensive nature of interviews, we argue that the presence of two reviewers during the interviews, with different roles, allowed us to capture a larger spectrum of behavior-related mistakes.

The findings from study 1 may be valid for group interviews performed in analogous settings, i.e., with a single customer, and with one or two projects. Furthermore, the majority of the students considered are non-native English speakers, conducting interviews in English. Different results may be obtained with native English speakers, and one-to-one interviews. Furthermore, the experiment was carried out by observations in only the first interview, therefore the results are entirely based on the commitment of students to have done the preparatory work before attending the interview.

## 7.2 Study 2

In study 2 we had different data sources, data collection and analysis tasks, designed to remove some of the limitations of the first study. In this study, none of the authors/instructors were present at the time of interview, which was aimed to eliminate the researchers' bias from the analysis stage. That is, we did not have two data sources that were available in Study 1: (a) interview observer - O, and (b) customer think aloud - C. The interview audio files were assigned randomly to three reviewers without revealing to them the stage of interview or the group number. Furthermore, our data set was different in study 2, in that we did not include all the audio recordings of the 3 interviews for all groups, rather we selected a sample. We considered groups that obtained different grades for their final SRS (3 of the highest marks, 3 of the average marks and 3 of the lowest marks), arguably assuming that this would cover groups with different observable behaviour and, in turn, observable mistakes, also during interviews. Another threat for the second study is related to the approach adopted to count the mistakes. This was performed based on a questionnaire (Appendix A), which required personal judgment, hence subjective evaluation. To mitigate the subjectivity threat, for each interview, two experts reviewed each interview, and filled the questionnaire independently. The presented results are the average of the scores given by each expert.

Another point to consider the observation of the all the reviewers from study 1 and study 2 is that the person playing the role of the customer in study 1 and study 2 may also have impacted the results. In study 1 it was the teaching assistant (first author) who is experienced in RE teaching, had previous practice of role-playing activities and was involved in the research. In study 2, the casual academics were not experienced in RE (they were PhD students in computer science), and were involved in role-playing activity for the first time. However we argue that, in study 2, this adds to the authenticity of assessment task based on guidelines of Dawson's tricks [59] by presenting "*uncertain and naive customer*" who is not the teacher and hence the students cannot fall for the assumption that the teacher (playing the customer role) should provide correct, clear and consistent answers in all three interviews.

In study 2, one person played the role of different stakeholders in three interviews. Having the same person playing different roles may impact on the realism of the elicitation process, and on the performance of students, especially concerning the task of building rapport with the customer. In study 2, this limitation was due to constraints on the hiring budget for the assessment.

## 8. Conclusion and Future Works

We have presented a research design for conducting an observational study of mistakes that novices make in requirements elicitation interviews. We also provided the results from the qualitative analysis of empirical data collected from multiple sources in this study. The significant number of mistakes observed and their classifications into 7 distinct themes provide a useful resource for educationists and trainers who wish to include elicitation interview training in their curriculum. We have also identified the aspects of elicitation interviews where the students struggle the most across three separate interviews. These aspects are indeed the ones that educators need to pay particular attention to.

Education research has shown that in general the pedagogical approaches that we have utilized are effective for education and training, namely: collaborative learning, role-playing activity, corrective feedback learning, and authentic assessment. Our study reaffirms this in the context of REET. We believe that all of our contributions are not only useful in a university setting but also equally valuable in RE industry training.

The students did not improve much towards later interview stages. This suggests that giving general class feedback to the students, as in our current pedagogical approach, appears not to be enough for them to learn from their mistakes. We therefore argue that novel pedagogical approaches are needed to improve students' abilities and awareness of their mistakes. To this end, we are currently developing and experimenting a novel training protocol, in which the student themselves are required to listen to their own interview recordings and identify their mistakes, based on the questionnaire used also in the current study. This approach, which includes phases of self-assessment and a peer-review, will hopefully provide more guidance to the students.

In future, we plan to review not only the audio recordings but also the video recordings of the interviews for mistakes present in non-verbal communications, along the lines of Karras et al. [73]. Indeed, some mistakes associated with inappropriate and unprofessional behaviour, e.g., arriving late, or not looking at the customer, can be clearly observed only with a video analysis. We argue that these mistakes may have a major impact on the rapport and trust-based relationship that the analyst is supposed to establish with the customer.

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## Appendix A: Interview Questionnaire

Please rate your agreement with the following statements about QUESTION

**FORMULATION** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

- The analyst asked vague questions
- The analyst asked technical questions
- The analyst asked questions that appeared irrelevant to me
- The analyst asked the customer for solutions
- The analyst asked long and overly complex questions
- The analyst formulated their questions in a way that appeared incorrect to me
- The analyst asked vague questions
- The analyst asked technical questions
- The analyst asked questions that appeared irrelevant to me
- The analyst asked the customer for solutions
- The analyst asked long and overly complex questions
- The analyst formulated their questions in a way that appeared incorrect to me

Please rate your agreement with the following statements about QUESTION

**OMISSION** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

- The analyst DID NOT ask for additional stakeholders
- The analyst DID NOT ask probing questions to confirm their understanding
- The analyst DID NOT ask about the existing system or business process
- The analyst DID NOT ask questions about feature prioritisation
- The analyst DID NOT ask information about the problem domain
- The analyst DID NOT identify goals and success criteria
- The analyst DID NOT ask all the questions that I consider relevant
- The analyst DID NOT ask for additional stakeholders
- The analyst DID NOT ask probing questions to confirm their understanding
- The analyst DID NOT ask about the existing system or business process
- The analyst DID NOT ask questions about feature prioritisation
- The analyst DID NOT ask information about the problem domain
- The analyst DID NOT identify goals and success criteria
- The analyst DID NOT ask all the questions that I consider relevant

Please rate your agreement with the following statements about ORDER OF

**INTERVIEW** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

- The analyst DID NOT perform a summary at the end of the interview
- The analyst started the interview by asking direct questions about the system
- The analyst asked questions in an order that appeared incorrect to me
- The analyst repeated the same questions multiple times
- The analyst DID NOT perform a summary at the end of the interview
- The analyst started the interview by asking direct questions about the system
- The analyst asked questions in an order that appeared incorrect to me
- The analyst repeated the same questions multiple times

Please rate your agreement with the following statements about COMMUNICATION

**SKILLS** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

- The dialogues style used by the analyst appears unnatural to me
- The analyst showed poor communication skills
- The analyst showed poor listening skills
- The analyst spoke with a low and unclear tone

The dialogues style used by the analyst appears unnatural to me  
The analyst showed poor communication skills  
The analyst showed poor listening skills  
The analyst spoke with a low and unclear tone

**Please rate your agreement with the following statements about ANALYST**

**BEHAVIOUR** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

The analyst showed lack of confidence  
The analyst appeared overconfident or arrogant  
The analyst showed a passive attitude  
The analyst showed a behaviour that appeared unprofessional to me  
The analyst showed lack of confidence  
The analyst appeared overconfident or arrogant  
The analyst showed a passive attitude  
The analyst showed a behaviour that appeared unprofessional to me

**Please rate your agreement with the following statements about CUSTOMER**

**INTERACTION** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

The analyst DID NOT create rapport with the customer  
The analyst tried to influence the customer  
The analyst interrupted the customer  
The analyst DID NOT create rapport with the customer  
The analyst tried to influence the customer  
The analyst interrupted the customer

**Please rate your agreement with the following statements about TEAMWORK and**

**PLANNING** \* [Strongly Agree (1), Agree (2), Not sure (3), Disagree (4), Strongly Disagree (5)]

There was lack of coordination and choreography among team members  
The analyst did NOT manage their time in a proper way  
The analyst showed a lack of preparation on the domain  
The analyst looked like they did not plan the interview  
There were long pauses during the interview  
There was lack of coordination and choreography among team members  
The analyst did NOT manage their time in a proper way  
The analyst showed a lack of preparation on the domain  
The analyst looked like they did not plan the interview  
There were long pauses during the interview

## Appendix B: Group performance based on SRS Document Assessment

We had three groups each for top marks, average marks and the lowest marks. We were interested to see whether their performance during the interviews had any correlation with their understanding that lead to writing the SRS document. For ease of visualisation we have divided the interview themes into further two categories i.e. Domain specific aspects of elicitation interview (Question Formulation, Question Omission and Interview Order) and Social aspect of interview (Communication Skills, Analyst Behaviour, Customer Interaction, and Teamwork and Planning). The higher scores show better performance and the lower scores show poor performance.

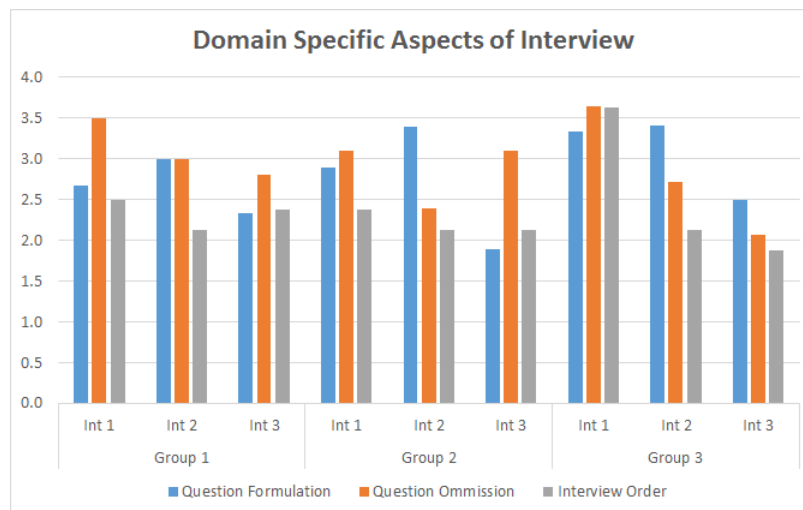


Fig. 20. Performance of Groups with top marks in Domain Specific Aspects of interview

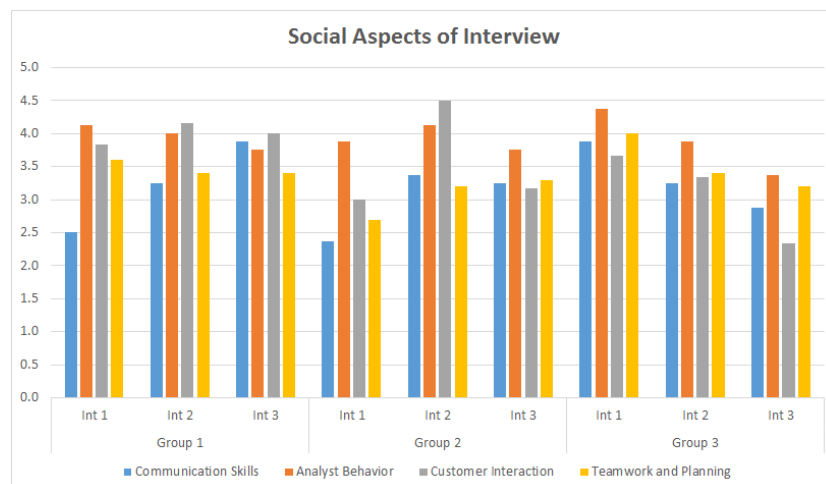


Fig. 21. Performance of Groups with top marks in Social Aspects of interview

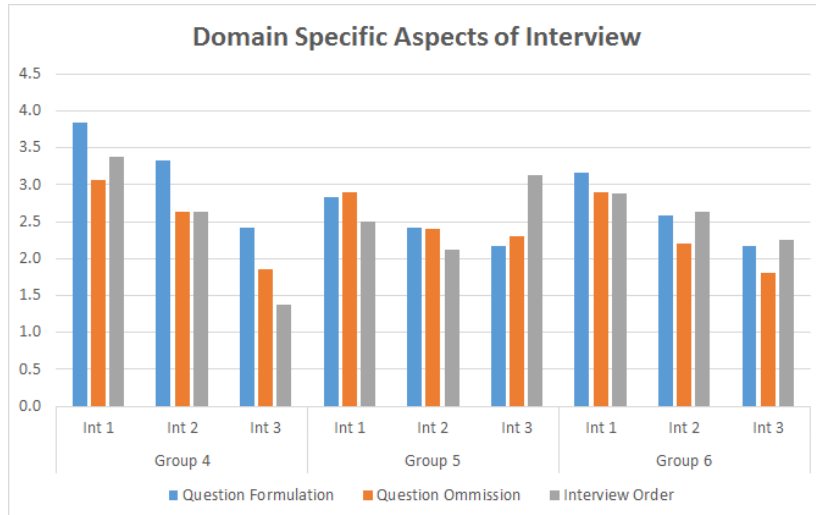


Fig. 22. Performance of Groups with average marks in Domain Specific Aspects of interview

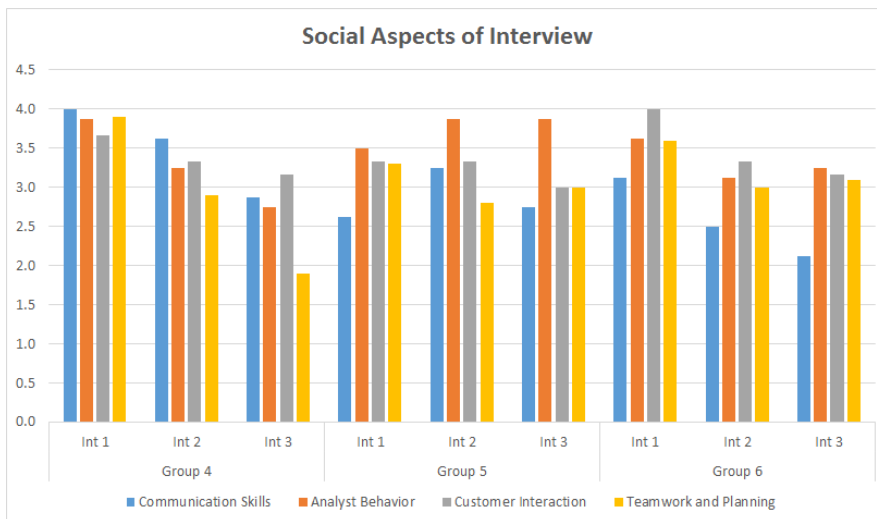


Fig. 23. Performance of Groups with average marks in Social Aspects of interview

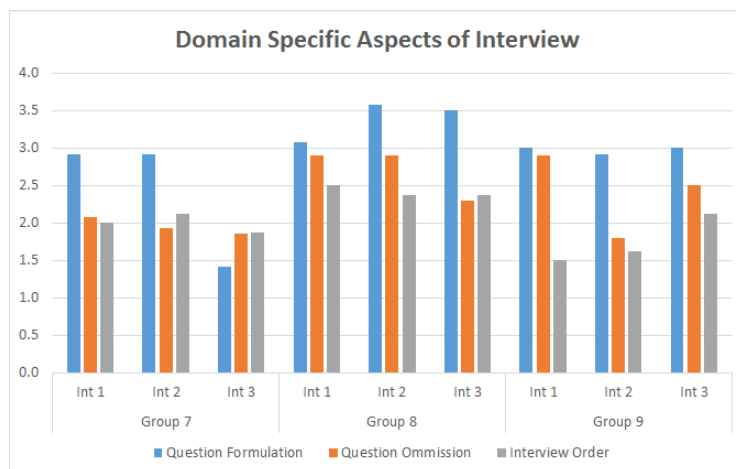


Fig. 24. Performance of Groups with lowest marks in Domain Specific Aspects of interview

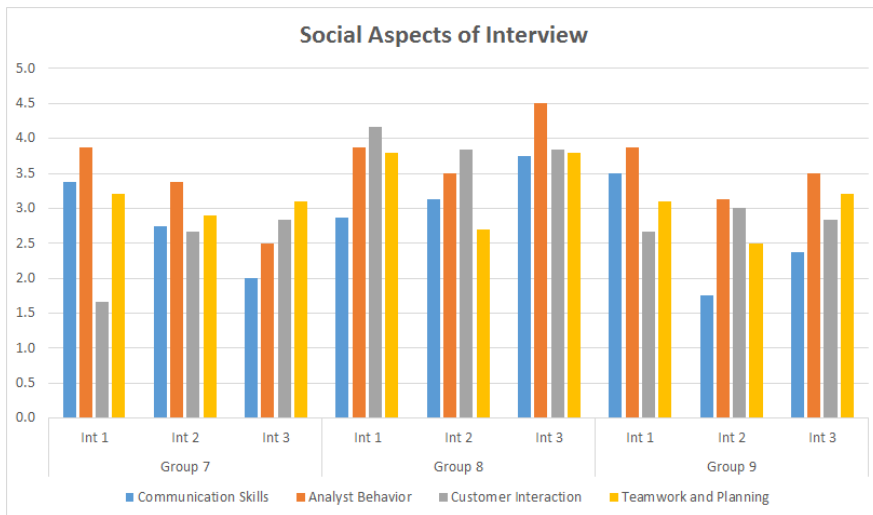


Fig. 25. Performance of Groups with lowest marks in Social Aspects of interview