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Assessing the ESP Needs of Saudi Engineering Undergraduates: A Diagnostic View

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Abstract
The recent development in the field of science, technology and commerce has revived the significance of English language teaching and learning in Saudi Arabia. The Saudi educational policies are envisioned to configure the students' communicative competence in English to the demands of the specific professional disciplines as well as the global market. Engineering undergraduates studying at Saudi public universities rely on the Preparatory Year Programme (PYP) to meet their English language needs. However, it seems that no empirical study to date has been conducted to analyse the English language needs of the engineering undergraduates. This study aims at analysing the English for Specific Purposes (ESP) needs of engineering undergraduates studying at a Saudi university. It intends to identify what academic tasks they often carry out in English. The researcher adopted a mixed-methods approach by employing a questionnaire and interviews to collect data from 257 engineering undergraduates and 32 content-subject teachers. Quantitative data analysis was performed using SPSS, while qualitative data were analysed through NVivo software. The participants' perceptions of target tasks were compared and examined to see if there are significant differences between the groups based on the specialty of department or year of study. Overall, 27 tasks were identified as most frequently performed by undergraduates across all engineering departments at the university. The findings also revealed significant differences in the undergraduates' responses across all four levels of study. The findings suggest incorporating those tasks into the current ESP syllabus which are aligned to the immediate needs of undergraduates of engineering departments.

Keywords: academic tasks, engineering undergraduates, English for Specific Purposes, needs analysis, Preparatory Year Programme

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1. Introduction

In higher education of Saudi Arabia, most of the public universities use English as the medium of instruction for specific academic programmes, primarily, including medicine, engineering, business administration, computer science, information sciences and applied sciences (Alfehaid, 2018). The main source of intake at these universities comprises students graduated from government schools where English is taught as a foreign language. However, the majority of students from these schools, in spite of studying English for nine years, i.e., from grade 6 elementary to grade 12 secondary, lack basic English language skills to meet the linguistic demands for success in their university core courses (Asmari, 2016). With a low level of English competence, they face significant difficulty in their English medium classes and courses (Alrashidi & Phan, 2015). According to Omar and Alrubayea (2012), this disproportional gap between the secondary school level and the university level causes students to drop courses or quit college entirely. To bridge the gap between the two levels and acculturate students to university education, almost all Saudi universities have started introducing a one-year-long Preparatory Year Programmes (PYP). The Preparatory year is the first year of the study plan at the university level preparing newly admitted students for their undergraduate study by developing their basic communication skills in English, general study skills and computer skills. At this stage, they also have to study prerequisite subjects for entering the next level of their specialized discipline.

The university, where this study was carried out, is one of the oldest universities in Saudi Arabia which implemented the preparatory year system in 2004 (College of Engineering and Islamic Architecture [CEIA], 2019). The English language Programme of the PYP is committed to empower students to achieve an intermediate level (i.e., B1 on the Common European Framework of Reference for Languages (CEFR) scale) in general English language and an adequate level of competence in English specifically used in their content subjects to pursue their academic education at university and later in their professional careers (Melibari, 2015; Arnó-Macià & Mancho-Barés, 2015).

The College of Engineering and Islamic Architecture (CEIA) and the College of Computer and Information System (CCIS), followed by Health colleges and the College of Business Administration, are the largest beneficiaries of the existing PYP of the university. At the time of entering their subject-specific departments, i.e., the departments of Civil, Computer, Electrical and Mechanical Engineering, the PYP graduates are perceived to be prepared both in general and technical English as per the standards of ABET-accredited engineering programs of these four departments. However, the engineering faculty often expresses dissatisfaction with the English language abilities of their students in carrying out various academic activities. This suggests that the present English for General Purposes (EGP) and English for Specific Purposes (ESP) courses do not properly harmonize with the academic and professional needs of the engineering undergraduates. Consequently, students' low language skills seem to hinder progress in studying their specialized subjects and, later, in meeting the communication needs of their professional practices.

Since the inception of the PYP at the university, it has been relying on commercially published instructional materials in teaching both EGP and ESP courses. Therefore, without conducting a needs analysis, it is difficult to say to what extent the present course materials are in line with the students' mainstream curriculum. However, even the best commercial materials, available in the international arena, are often criticized for being generic or not well-informed about the cultural and educational context of a specific group of learners (Howard & Major, 2004). In this vein, the present study will help in providing recommendations to tailor the present ESP teaching materials according to the immediate needs of the engineering undergraduates of the university.

In this Needs Analysis study, the ESP needs of the undergraduates will be retrieved in the form of target tasks which the undergraduates and their content-subjects teachers perceive essential for the successful completion of engineering students' undergraduate level study. Thus, the objectives of the study are: first, to identify and prioritise the most frequent tasks engineering undergraduates carry out in English in their engineering study; and second, to compare the undergraduates' and the subject teachers' perceptions of tasks based on their importance to their respective departments (i.e., the Civil, Electrical, Mechanical, and Computer Engineering) as well as four levels (years) of study (i.e., 2nd year to 5th year). Based on these objectives, the study aims to answer the following two research questions:

Q.1: What are the academic tasks that engineering undergraduates carry out in English across all engineering departments at a Saudi public university?
Q.2: Are there significant differences in the participants' perceptions of tasks, which can be attributed to the specialty of department or year of study?

2. Literature Review

ESP is "the role of English in a language course or program of instruction in which the content and aims of the course are fixed by the specific needs of a particular group of learners" as defined by Richards and Schmidt (2010, p. 198). Thus, the selection of teaching materials and techniques is dependent on the learner's needs, which means that the success of teaching and learning process in ESP contingent much on a needs analysis (Cowling, 2007). However, without conducting a needs analysis, how can those specific needs be identified? So, needs analysis is used as a tool to identify the types of activities and tasks performed by students in different disciplines and their needs of English language skills to complete their major courses successfully (Alastal & Munir, 2012).

The present study is embedded in the theoretical framework of needs analysis (NA) based on ESP theories, especially, established by Dudley-Evans and St. John (1998), Brown (2016), and Long (2005).

There are several terms used in the literature to refer to different types of learner's needs, such as objective and subjective needs, perceived and felt needs, process-oriented and product-oriented needs, and target situation and learning needs. Target needs split up further into three distinctions, namely "necessities, wants and lacks" (Hutchinson & Waters, 1987, p. 54). The relatively new model of needs analysis in ESP, suggested by Dudley-Evans and St John (1998) considers these different perspectives of needs by subsuming them under three categories: TSA (Target Situation Analysis), LSA (Learning Situation Analysis) and PSA (Present Situation Analysis). In target situation analysis, we investigate objective, perceived and product-oriented needs; a learning situation analysis inquires about subjective, felt and process-oriented needs, and a present situation analysis estimates strengths and weaknesses in language or learning skills.

Dudley-Evans and St John's (1998) model focuses on the following types of information or situations needed to establish a needs analysis:

A. professional information about the learners: the tasks and activities learners are/will be using English for – *target situation analysis* (TSA) and objectives needs
B. personal information about the learners: factors which may affect the way they learn such as previous language learning experiences, cultural information, reasons for attending the course and expectations of it, attitude to English – *wants, means, subjective needs*
C. English language information about the learners: what their current skills and language use are – *present situation analysis* (PSA) – which allow us to assess (D)
D. the learners' lacks: the gap between (C) and (A) – lacks
E. language learning information: effective ways of learning the skills and language in (D) – *learning needs*
F. professional communication information about (A): knowledge of how language and skills are used in the target situation – *linguistic analysis, discourse analysis and genre analysis*
G. what is wanted from the course
H. information about the environment in which the course will be run – *means analysis* (p. 125)

Given the time and resources restrictions, the current study considers only the first component (A) of the above model to identify the ESP needs of the engineering undergraduates.

Once decided that needs analysis is indispensable, the next thing is to determine what the students need to learn. This is the first but a difficult stage in a needs analysis process, it is because of the different views held by different stakeholders involved in an ESP programme. Brown (2016) categorized these *needs viewpoints* as (a) democratic view: whatever the most people want (b) discrepancy view: whatever is missing (c) analytic view: whatever logically comes next, and (d) diagnostic view: whatever will do most harm if missing. The present study considers the last viewpoint, the diagnostic view, in which the students' necessities or prerequisites in the target situation are identified and then prioritized based on their critical or pressing value. Brown (2016) maintains that "the needs analysts will first identify potential student needs, then prioritize those needs that are likely to have the most negative consequences if not addressed, then include less crucial needs if there is sufficient time" (p. 16).

Long (2005) endorsed taking a task-based approach to needs analysis as well as with the learning and teaching process. This recommendation is based on the view that "structures or other linguistic elements (notions, functions, lexical items, etc.)" have a secondary role in fulfilling a task requirement. "Learners are far more active and cognitive-independent participants in the acquisition process than is assumed by the erroneous belief that what you teach is what they learn, and when you teach it is when they learn it" (Long, 2005, p. 3). In line with this approach, tasks or communicative events (for instance, listening to lectures, participating or leading academic discussions, writing lab or project reports, and delivering presentations) are taken as the unit of a needs analysis. Then the researcher gathers “exemplars of those language uses” by recording lectures, seminars, teacher-student discussions, etc. or by collecting the written texts like exam papers, and project reports.

Some of the recently conducted needs analysis studies that are relevant to the current study in terms of context, research methods, scope, etc. have also adopted a task-based approach. An in-depth task-based needs analysis was conducted by Malicka, Guerrero, and Norris (2017) who studied the English language needs of hotel receptionists. They interviewed five expert hotel receptionists and five novice receptionists to get information about daily tasks and their frequency, while observations were carried out in the workplace to catch the linguistic aspects and difficulty of the target tasks. The study concluded that the information about the target tasks and their frequency would help in prioritizing the tasks to be included and ordered in a curriculum. It also added that the insights about the linguistic difficulty could be used to select lexical items for the pre- or post-task phases of a task. The study relied only on qualitative data on oral tasks.

Adopting a mixed-methods, triangulated needs analysis, Caplan and Stevens (2017) conducted a study to revise the present EAP programme at a US university. An online survey was given to 191 students and 226 faculty members, while five international students were interviewed. The faculty members and students showed consensus on 21 tasks/activities that are important for undergraduate classes. However, the faculty did not agree to the students’ views about their ratings in the successful completion of these tasks.

To identify target needs of the students of the Fine Arts in a private university in Turkey, Kazar and Mede (2015) collected both quantitative and qualitative data using a questionnaire and semi-structured interviews respectively. The results revealed that presentation skills, learning key terms, writing email messages, and reading academic texts are important tasks and ESP program should focus on those learning strategies required by these tasks.

Serafini and Torres (2015) conducted a multiphase needs analysis to design a university business Spanish course. First, the researchers generated a list of 40 relevant target tasks with the help of business graduates and professionals. Secondly, university business majors rated the frequency and difficulty of each task on a 40-item Likert-type questionnaire. Finally, the researchers analysed and grouped target tasks identified in the needs assessment to create five major target task types that informed course objectives and classroom tasks.

Apart from the abovementioned studies, a number of needs analysis studies based on general language skills, syntax, lexical items, etc. have been conducted to inform different types of academic syllabuses for engineering students in Saudi Arabia (Abu-Rizaizah, 2005; Alsolami, 2014; Habbash & Albakrawi, 2014; Mahmoud, 2014; Alsamadani, 2017; Alshabeb, Alsubaie & Albasheer, 2017). However, no attempt has been made to conduct a task-based needs analysis to design an ESP syllabus for engineering undergraduates in the Saudi context. This study sets out to fill this gap by providing empirical data on tasks obtained through a target situation analysis (Dudley-Evans & St John, 1998) carried out in the engineering departments of a Saudi university.

3. Method

New studies are giving attention to task-based analyses by using triangulating data sources/methods that enhance the validity of research findings (Cowling, 2007), and subsequently, reflect a clear picture of the complex reality of the learners' needs. Aligning with the notion of triangulation, mixed-methods approaches are recommended by researchers (Long, 2005; Brown, 2016). Mixed methods can be described as one of a variety of combinations of qualitative and quantitative methods within a single project of inquiry. In the current context, integrating these two approaches will help to best understand the research problem as well as provide a more comprehensive view of the needs of the ESP learners.

3.1 Participants and Sampling

The main source of relevant information for this study included two different populations: undergraduates and content-subject teachers from the departments of Civil, Electrical, Mechanical, and Computer Engineering. The student participants of the study are Arab speaking Saudis currently studying at different levels ranging from the 2nd year to the 5th year. The subject teachers are content specialists teaching different engineering subjects to the students of the four departments. The role of domain experts, as a reliable source of accurate information, has often been emphasized by researchers (Huh, 2006). The findings of Gilabert's study (2005) also support "Long's claim that, if only one source is to be used in a needs analysis, domain experts should be that source, rather than students, scholars, company representatives, or applied linguists" (p. 197). Likewise, Attan, Abdul Raof, Hamzah, Mohd Omar and Md Yusof (2016) highly recommend domain experts' point of view as more accurate than the views of students who lack knowledge and experience of their future career.

For the quantitative part of the study i.e., using a questionnaire, Krejcie and Morgan's (1970) sample size table was used to establish a sample size from the engineering undergraduates. Then cluster sampling procedure was adopted to randomly select the required sample size from the undergraduates, while the content-subject teachers participated in this study as samples of convenience. Table 1 shows the distribution of the participating content-subject teachers by their department and undergraduates both by their department and year of study.

Table 1. *Distribution of undergraduate & content-subject teacher participants*

	Undergraduates					Subject Teachers
Department	2nd year	3rd year	4th year	5th year	Total (%)	Total (%)
Electrical	16	6	49	23	94 (36.58)	10 (31.25)
Mechanical	7	18	39	3	67 (26.06)	7 (21.88)
Civil	8	8	5	16	37 (14.40)	7 (21.88)
Computer	11	17	18	13	59 (22.96)	8 (25.00)
Total	42	49	111	55	257 (100)	32 (100)

3.2 Data collection instruments

For collecting both quantitative and qualitative data, two different research instruments were used: a set of questionnaires for content-subject teachers and undergraduate students, and semi-structured interviews. Thus, to enhance the credibility and dependability of the findings of the study, two types of triangulation were combined: stakeholder triangulation (students and teachers) and method triangulation (questionnaire and interviews) (Brown, 2016).

3.3 Procedure

Following a thorough literature review on the needs of the engineering students and a detailed discussion with the content-subject specialists from the engineering departments, a final list of 35 academic tasks was compiled. Based on these tasks which were divided into six task categories or super-ordinates, a 5-point Likert scale questionnaire was designed. Each category represents a type of situation where undergraduates perform different academic tasks. Next, two English language professors teaching at the PYP, checked the questionnaire for any language issues or ambiguous questions. Based on their suggestions, a few minor modifications were made in the questionnaire.

The content-subject teachers' version of the questionnaire was piloted with five teachers followed by interviews. The interviews proved helpful in understanding the respondents' choices and clarifying any of their confusion that might arise in understanding some of the items or terminology. Based on the feedback from the content-subject specialists, some more changes were made in the contents of the questionnaire.

Corresponding to the content-subject teachers' questionnaire, another version of the questionnaire was developed for the undergraduates. Then it was translated from English to Arabic by a professor in English from Arabic background and piloted with a sample of 16 engineering undergraduates. The internal consistency of the 35 Likert-type items of both versions was established collectively through Cronbach's Alpha with the coefficient value of 0.89.

During the middle of the second semester of the academic year 2017-2018, the English version of the questionnaire was distributed among the content-subject teachers in their offices, whereas the Arabic version was distributed among students during their class time. A total of 289 questionnaires were completed by the two participant groups. The quantitative data from the questionnaires were analysed through SPSS programme. For statistical purposes, the responses in frequencies were coded as 0 = Never, 1 = Rarely, 2 = Sometimes, 3 = Often, and 4 = Very often. Then the first two low-frequency values (i.e., 0 and 1) were further recoded as "infrequent' meant the tasks which are not commonly practiced by engineering undergraduates and the high-frequency values (i.e., 2, 3 and 4) as "frequent" representing the tasks commonly performed across all the four departments. Next, the "infrequent" responses were assigned a value of "0", while a value of "1" was assigned to the "frequent" ones. Thus, based on calculating frequencies and percentages, if an item received 50% or more of the total responses in "0" or "1", it was categorized as "infrequent" or "frequent" respectively. Finally, the results were analysed through the Mann Whitney U test to see if there is a significant difference between the content-subject teachers' and undergraduates' responses, and Kruskal Wallis Test to estimate any discrepancies or similarities found among the four departments or the four levels of study.

Semi-structured interviews were conducted with 16 content-subject teachers from the four engineering departments. Each of the interviews was carried out in the office of the respective interviewee. The interviews' time spans varied from 30 to 90 minutes, and they were audio-recorded. All interviews were transcribed and imported to NVivo 12 software to be coded. Initially, the data from the interviews were coded as nodes according to the six predetermined categories of tasks derived from the questionnaire, and then they were further coded as sub-nodes representing different academic tasks. Next, they were thoroughly reviewed and summarised in a coherent and meaningful way. Finally, the summarised ideas were interpreted and evaluated in relation to the relevant research question.

4. Findings and Discussion

This section provides answers to the two research questions that were presented in the introduction section. Both the quantitative and qualitative data are parallelly aligned. Thus, the statistical results of the questionnaires were viewed and interpreted in the relationship to the findings of the interviews.

4.1 Engineering academic tasks

In table 2, the results of all 35 tasks from the questionnaires are shown in frequency counts and percentages for each respondent group individually as well as in total. In each of the six category-types, tasks are arranged in descending order based on the total frequencies of the responses.

Table 2. *Participants' responses on the engineering academic tasks*

Category-type Tasks	Subject teachers	Undergraduates	Total
Teacher-student communication			
1. Face to face meeting	29(90.6%)	197(76.7%)	226(78.2%)
2. Email	20(62.5%)	182(70.8%)	202(69.9%)
3. University/personal website	19(59.4%)	132(51.4%)	151(52.2%)
4. Phone call	12(37.5%)	91(35.4%)	103(35.6%)*
Writing a document			
5. Lab report	28(87.5%)	209(81.3%)	237(82.0%)
6. Graduation project report	29(90.6%)	181(70.4%)	210(72.7%)
7. Term paper	17(53.1%)	192(74.7%)	209(72.3%)
8. Summer training report	26(81.3%)	164(63.8%)	190(65.7%)
9. Research paper or article	9(28.1%)	173(67.3%)	182(63.0%)
10. Summaries	16(50.0%)	167(65.0%)	183(63.3%)
11. Curriculum Vitae (CV)	3(9.4%)	140(54.5%)	143(49.5%)*
12. Field trip report	14(43.8%)	105(40.9%)	119(41.2%)*
Inside the classroom or lab. activities			
13. Listening to lectures/lab instructions	29(90.6%)	229(89.1%)	258(89.3%)

14. Asking/answering questions from the teacher	27(84.4%)	214(83.3%)	241(83.4%)
15. Taking notes while listening to lectures	27(84.4%)	208(80.9%)	235(81.3%)
16. Explaining or demonstrating (e.g. an experiment or procedures, etc.)	23(71.9%)	204(79.4%)	227(78.5%)
17. Watching videos or computer simulations	17(53.1%)	189(73.5%)	206(71.3%)
18. Reading subject specific texts (e.g., textbooks, handouts, notes, etc.)	27(84.4%)	178(69.3%)	205(70.9%)
19. Participating in group discussions	17(53.1%)	160(62.3%)	177(61.2%)
20. Reading manuals, safety rules or notices	19(59.4%)	143(55.6%)	162(56.1%)
Types of the exam or graded work			
21. Solving numerical questions with equations and formulas	31(96.9%)	226(87.9%)	257(88.9%)
22. Drawing circuits, symbols and graphs	32(100.0%)	208(80.9%)	240(83.0%)
23. Writing short answers	25(78.1%)	172(66.9%)	197(68.2%)
24. Multiple-choice questions (MCQs)	21(65.6%)	133(51.8%)	154(53.3%)
25. An in-class open book test	17(53.1%)	111(43.2%)	128(44.3%)*
26. Daily end-of-lesson or -topic assessment	16(50.0%)	99(38.5%)	115(39.8%)*
Presentations			
27. Listening to presentations	29(90.6%)	194(75.5%)	223(77.2%)
28. Delivering presentations	25(78.1%)	178(69.3%)	203(70.2%)
29. Describing the content of tables, graphs and diagrams	24(75.0%)	178(69.3%)	202(69.9%)
Other situations			
30. Using the internet for searching engineering-related information	28(87.5%)	237(92.2%)	265(91.7%)
31. Using a computer for word processing or data analysis (e.g., Word or Excel)	28(87.5%)	224(87.2%)	252(87.2%)
32.Translation (from English to Arabic or vice versa)	14(43.8%)	157(61.1%)	171(59.2%)
33.Reading newspaper or magazine articles related to engineering studies	11(34.4%)	130(50.6%)	141(48.8%)*

34. Reading journal articles or conference papers	5(15.6%)	107(41.6%)	112(38.8%)*
35. Attending seminars or conferences	7(21.9%)	89(34.6%)	96(33.2%)*

*below the cut-off point

A total of 27 out of 35 tasks was reported as "frequent" by more than 50% of the total 289 respondents including both content-subject teachers and undergraduates. Only eight tasks fell short of the cut-off point (50% of the total responses) to be considered "frequent." Except for two tasks (number 9 and 32), all of the "frequent" tasks received more than 50% responses from each group. Although the two tasks were perceived as "frequent" by the undergraduates, the content-subject teachers seemed to hold these two tasks as "infrequent."

Regarding the three frequent tasks of "teacher-student communication", the most frequent task that the participants reported was "face-to-face meeting" (78.2%), followed by "email" (69.9%) and "university/personal website" (52.2%). There was only one task, "phone call" (35.6%), which was reported as "infrequent." These results are in agreement with those of the interviews conducted with 16 content-subject teachers who confirmed that they often contact their students through emails, but very few students write emails in English. They added that the students usually preferred to talk to them in the class after lectures or visit their offices during office hours. Most of the teachers do not like sharing their phone number with the students, yet some of them feel comfortable to share things with the students through WhatsApp. Some of the interviewees reported that they used WhatsApp or social media to communicate with their students. This shows that the use of social media, especially WhatsApp, is becoming an increasingly popular means of communication between teachers and students.

In relation to the tasks "writing a document" category, "lab report' (82%), "graduation project report" (72.7%), and "term paper" (72.3%) were perceived as the three most frequent tasks that the engineering undergraduates perform in their departments. In the same category-type, an important technical document, "summer training report", was considered as "frequent" by 81.3% content-subject teachers, but due to the rather low response rate from the undergraduates (63.8%), it could not find a place in the top three ranks. One task namely "curriculum vitae (CV)" (49.5%) was reported as "infrequent" in this category although it received a reasonably high response rate from the undergraduates. The results from the interviews indicated that "graduation project report", "lab. report", and "summer training report" were mandatory and, thus, the most important writing tasks for the engineering undergraduates. Despite assigning 3rd rank to "term paper" in this category by the questionnaire respondents, very few interviewees described it in the same way. They had different perceptions of the term "term paper" such as "a final term exam", "a research paper", and "a written assignment on a specific topic". All the respondents said that CV writing is not part of their course. At least, students do not need it much during their studies, they might need it later for other purposes. Majority of the teachers confirmed that students did not need or write "research paper" to publish at the undergraduate level.

The largest category-type, "inside the classroom or lab activities", comprised of eight "frequent" tasks in which the top three were generic academic tasks, that is, "listening to lectures/lab. instructions" (89.3%), "asking/answering questions from teacher" (83.4%), and "taking notes while listening to lectures" (81.3%) followed by three technical ones, that is, "explaining or demonstrating (e.g. an experiment or procedures, etc.)" (78.5%), "watching videos or computer simulations" (71.3%), and "reading subject specific texts" (70.9%). Although a high percentage of subject teachers (84.4%) reported "reading subject specific texts" as a "frequent" task, fewer undergraduates (69.3%) opted against the same task. This category did not have any "infrequent" tasks. The majority of the interviewees stressed the importance of reading textbooks, handouts and PowerPoint slides in English. Very few interviewees mentioned "listening to lectures or lab instructions" as an academic task. One interviewee said, "most of the teachers use PowerPoint slides for their lectures. If a teacher is non-Arab, he teaches in English. If he is an Arab, he uses either both English and Arabic by mixing them or only Arabic." Although students ask or answer questions from teachers usually in Arabic, some good students ask questions in English. As for "explaining or demonstrating an experiment or procedures," one interviewee said that this activity is needed in exams only, otherwise, the teachers themselves do such activities, not the students. Another said that students do it on the computer by preparing slides, one-page memo, and Excel charts. Students do not participate in discussions in their early stage of studies. According to an interviewee, discussions may be needed in some courses but not in others. A Mathematics teacher stated that students usually had discussions in Arabic while solving a question in groups, which is acceptable because their focus is on Mathematics not on English. Students are supposed to take notes every day. They usually write what the teacher explains and solves on the board or displays on the slides. They have very little English texts on the slides or board, mostly equations, numerical or formulas. As for computer simulations, one interviewee said that he usually wrote on the board, so it was difficult for him to use simulation as well. Two other interviewees said that they sometimes performed simulations in the class.

The category related to "types of exam or graded work" consists of four academic "frequent" tasks, namely, "solving numerical questions with equations and formulas" (88.9%), "drawing circuits, symbols and graphs" (83%), "writing short answers" (68.2%), and "multiple choice questions (MCQs)" (53.3%). Here, the first two technical types of exam questions received much higher responses from both the groups of respondents than the last two general types of questions. The first one was chosen as "frequent" by 96.5% content-subject teachers and the second one by 100%, making them the two most frequent tasks for the content-subject teachers, and, at the same time, the most unanimously selected option by any of the two groups. This category included two "infrequent" tasks, that is, "in-class open book test" (44.3%) and "daily end-of-lesson or -topic assessment" (39.8%). The results from the interviews showed that there were a lot of questions in the exams or classroom activities where engineering students need to draw diagrams of circuits or to solve a numerical question about a given circuit. Most of the engineering courses are based on numerical or mathematical solutions which have numbers, symbols, equations or formulas as the main elements to be assessed. This type of sub-activity is frequently used in exams in the form of MCQs or two to three pages long problem-solving questions. A large number of the teachers assess their students using MCQs in the exams or quizzes in which; however, students have to solve a numerical or equation by applying some formula to find the correct answer. "Open book test" is not a standard practice or activity to assess students' performance, so some teachers do not use it at all. Yet, in some computer subjects where students need to design a programme or apply it to a numerical problem, teachers let students get help from the book. Some teachers do "daily end-of-lesson or -topic assessment" orally after each lesson by asking concept checking questions (usually in Arabic), while others give quizzes after finishing a chapter. For most of the teachers, the short answer is a single word or a number. It does not require a full sentence to write in English text.

Regarding the three tasks in "presentations", all of them were reported as "frequent." The first one (listening to presentations) received a total of 77.2% responses which were slightly higher than the responses of each of the last two tasks, i.e. delivering presentations (70.2%), and describing the content of tables, graphs, and diagrams (69.9%). During the interviews, most of the teachers emphasized the importance of presentations. In some courses, students need to make presentations to present their mini-projects or term papers at the end of every semester. They also need it for presenting their final graduation project. In other courses, like Mathematics, they do not need presentations. There are a lot of diagrams which they need to describe; they often present such things in the labs or their graduation project reports.

The last task category i.e., "other situations" included three "frequent" and three "infrequent" tasks. The first task, "using the internet for searching engineering-related basic information", was given 91.7% responses by all the respondents. This was the highest response rate for a task among all the tasks included in the questionnaire. The second, "using computer for word processing or data analysis (e.g. Word or Excel)", also received a relatively high percentage of the total responses (87.2%) from both the participant groups. However, "translations" received a relatively low percentage (59.2%). Out of the three reported "infrequent" tasks, the first one, i.e. "reading newspaper or magazine articles related to engineering studies" turned out quite close to the cut-off point by getting relatively high responses from the undergraduates, while the other two tasks, "reading journal articles or conference papers" (38.8%), and "attending seminars or conferences" (33.2%) received comparatively low responses from both the participant groups. According to some interviewees, students usually need internet to make presentations on a specific topic, copying diagrams, downloading software programmes, doing home assignments, etc. Some teachers said that students need "Word" and "Excel" to make presentation slides or write reports. Besides, they may need some other data processing software programmes like MATLAB. As for translations, some teachers use translations as a teaching strategy. After or during a lecture, when the teachers feel that students are still not clear about a concept or a term, they usually make use of translation. Similarly, students often use translation as a learning strategy; they usually resort to Google translation to translate either in Arabic or English. According to most of the interviewees, "reading newspaper or magazine articles related to engineering studies", "attending seminars or conferences" and "reading journal articles or conference papers" are rarely performed by the undergraduates at the engineering departments.

The overall results across table 2 shows that the most frequent target task, according to the total percentage of responses, is "using internet for searching engineering-related basic information" (91.7%), the second-highest is "listening to lectures/lab instructions" (89.3%), and the third is "solving numerical questions with equations and formulas" (88.9%).

The responses, which were elicited from both the content-subject teachers and undergraduates through questionnaires, were then compared by conducting a Mann-Whitney U test. Due to the limited space, only results with significant differences are presented. Results from the test showed that there were no significant differences between the responses of the content-subject teachers and undergraduates with regard to all the given tasks except for seven tasks. The following five tasks, responses of the undergraduates significantly exceeded those of the content-subject teachers: writing "term paper" (mean rank = 148.45, n = 257) comparing with (mean rank = 117.27, n = 32), (U = 3224.5, Z = -2.57, p = .01), "research paper / article" (mean rank = 151.27, n = 257) comparing with (mean rank = 94.64, n = 32), (U = 2500.5, Z = -4.32, p = .000), "curriculum vitae (CV)" (mean rank = 152.22, n = 257) comparing with (mean rank = 87.05, n = 32), (U = 2257.5, Z = -4.80, p = .000), "watching videos or computer simulation" (mean rank = 148.27. n = 257) comparing with (mean rank = 18.77, n = 32), (U = 3272.5, Z = -2.40, p = .02), and "reading journal articles or conference papers" (mean rank = 149.16, n = 257) comparing with (mean rank = 111.58, n = 32), (U = 3042.5, Z = -2.84, p = .004).

Similarly, comparing the content-subject teachers' responses regarding the two other tasks with those of the undergraduates showed significant differences in favour of the former. They are writing "graduation project report" (mean rank = 170.95, n = 32) comparing with (mean rank = 141.77, n = 257), (U = 3281.5, Z = -2.41, p = .02), and "drawing circuits, symbols and graphs" (mean rank = 169.5, n = 32) comparing with (mean rank = 141.95, n = 257), (U = 3328, Z = -2.71, p = .01). The possible explanation for their disagreement on the first and the last two tasks could be the lack of knowledge or experience on the part of the undergraduates, especially from 2nd and 3rd years. The other remaining tasks (i.e. writing "research paper", "CV", and "reading journal articles or conference papers") seem to be students' wants or expectations (Brown, 2016) rather than their actual needs as no evidence could be produced from the interviews to support.

4.2 Comparing responses of participant groups

The aim of the 2nd research question was to confirm if there were any significant differences in the occurrences of tasks across all the four engineering departments and in each of the four years of study. A comparison analysis was made to examine the extent of differences in the participants' perceptions of tasks, which can be attributed to the specialty of department or year of study.

4.2.1 Comparison of responses based on the specialty of department

To probe any significant differences among the four engineering departments regarding their responses to the given academic tasks, a Kruskal-Wallis test was run. The test results indicated that the departments' responses differed significantly on seven tasks, while no significant differences were reported in the remaining 28 tasks. The detailed test statistics about the seven tasks are given in table 3.

Table 3. *Statistical analysis of the tasks in which the participants from four engineering departments differ significantly*

	Engineering departments & their mean ranks					
Tasks	Electrical	Mechanical	Civil	Computer	Chi-square	Sig.
1. Phone call	133.79	169.66	146.05	134.48	13.631	.003*
2. Lab. report	159.88	133.90	134.88	140.81	12.243	.007*
3. Field trip report	145.25	147.99	170.89	124.37	11.586	.009*
4.Taking notes while listening to lectures	153.94	146.61	122.74	143.96	9.542	.023*
5. Participation in group discussions	135.70	167.80	122.18	149.24	14.396	.002*

6. Solving numerical questions with equations / formulas	152.66	145.38	147.86	130.81	9.683	.021*
7. An in-class open book test	110.18	180.59	159.82	150.01	44.716	.000*

* p < .05

Table 3 presents statistics about the seven tasks, including four "frequent" (items 2, 4, 5 and 6) and three "infrequent" (items 1,3 and 7) tasks, for which the responses of the four departments varied significantly. The maximum level of significant differences (p = .000) can be seen among the four departments on item 7, especially between Electrical and Mechanical departments. This difference is slightly low (p = .002) and (p = .003) for items 5 and 1 respectively. The minimum level of significant differences (p = .023) and (p = .021) can be noticed for items 4 and 6 respectively. Although the mean ranks of the above four "frequent" tasks show that the departments significantly differ from each other, all these tasks were given more than 50% responses by each of the departments. It means that the frequency of the common responses for each task is higher than the frequency of the responses in which the departments have differences. Thus, none of the above tasks could be related exclusively to one department and exempted from others. Therefore, the specificity of these tasks to a particular department could not be established. It rather implies that all the 27 "frequent" tasks are carried out to various extents across all the four engineering departments.

4.2.2 Comparison of responses based on the year of study

Another Kruskal-Wallis test was conducted to examine the extent to which the responses of the four student-participant groups (i.e. 2nd year, 3rd year, 4th year and 5th year) regarding the 35 tasks were significantly different. The statistical results in table 4 show 12 tasks which illustrated significant differences in the responses of the four participant groups.

Table 4: *Statistical analysis of the tasks in which the student-participants from four different years of study differ significantly*

	Year of study & their mean ranks					
Tasks	2nd year	3rd year	4th year	5th year	Chi-square	Sig.
1. University/personal website	102.77	131.18	139.41	126.08	10.048	.018*
2. Term paper	97.25	116.92	139.50	142.81	23.060	.000*
3. Research paper/article	94.51	121.17	140.90	138.29	20.132	.000*
4. Field trip report	97.92	121.08	135.54	146.59	16.332	.001*
5. Summer training report	74.54	115.18	139.61	161.48	53.416	.000*
6. Graduation project report	62.98	114.55	146.16	157.65	78.544	.000*
7. Taking notes while listening to lectures	122.90	119.41	140.70	118.45	10.771	.013*

8. Reading subject specific texts (e.g., textbooks, handouts, notes, etc.)	110.37	123.92	141.87	121.77	10.516	015*
9. An in-class open book test	97.98	133.82	138.33	129.57	12.596	.006*
10. Delivering presentations	95.07	113.43	146.50	133.45	27.012	.000*
11. Describing the content of tables, graphs and diagrams	110.37	113.43	139.56	133.45	10.274	.016*
12. Using a computer for word processing or data analysis	114.90	121.90	136.24	131.46	9.148	.027*

* $p < .05$

The results of the test demonstrated that the four student groups significantly differed in responding to almost one-third (12) of the total tasks. Table 4 showcases statistics of the 12 tasks which include all "frequent" tasks except tasks 4 and 9. It is quite noticeable that the mean ranks of the 2^{nd} year group's responses to all the tasks except tasks 7 and 8 are substantially lower than the other three groups. Likewise, the overall mean ranks of the 3^{rd} year group's responses are to some extent lower than the 4^{th} and 5^{th} year groups. It may refer to the fact that most of the tasks (table 4) are related to the later stages of undergraduate studies. Therefore, the 2^{nd} and 3^{rd} year students might not perceive the importance of these tasks, especially at the early stage of their studies. They become more aware of what they need as they go through their studies getting exposed to more advanced courses in their field of specialization. For instance, only after completing 135 credit hours in the 7th semester, students become eligible to start working on the graduation project report. Similarly, students usually participate in their first summer training program at the end of the 3^{rd} year course after completing 75 credit hours. Regarding "delivering presentations" and writing "term paper", the 2^{nd} year syllabus consists of basic engineering subjects like Mathematics, general physics, statistics, etc., and three to four university compulsory subjects (all in Arabic): all these subjects do not require students to make presentations or write term papers. It is in the 3^{rd} year that students start to learn more technical or engineering-specific subjects. This is the reason that the responses of the 3^{rd} year students, especially in relation to technical tasks, tend to be more towards 4^{th} and 5^{th} year students than towards those in the 2^{nd} year. No significant differences were found between the responses of the 4^{th} and 5^{th} year students, which means that most of the tasks they perform in their respective levels are alike. Overall, the tasks of the 2^{nd} year seem discrete from those of the 4^{th} and 5^{th} years, while the tasks of the 3^{rd} year are comparatively identical to those of the 4^{th} and 5^{th} years.

4.3 Summary of the results of the study

In response to the first research question (i.e., What are the academic tasks that engineering undergraduates carry out in English across all engineering departments at a Saudi public university?), the results showed that out of 35 tasks given in the questionnaire, 27 tasks were identified as "frequent" or primary, since more than 50% of the total respondents chose high-frequency options for each of these tasks. We can assume that these tasks are often carried out by the engineering undergraduates in their departments. Only eight tasks did not reach the cut-off point, that is, 50% of the total responses, and thus to be considered "infrequent" or secondary. By conducting a Mann-Whitney U test to compare the responses of engineering subject teachers and undergraduates, it was confirmed that both groups agreed on a considerable number of tasks (28). They differed significantly only on seven tasks. The possible reasons behind their disagreement on these tasks were discussed in the previous section.

The findings, from the questionnaire, were triangulated with those of the semi-structured interviews to get more in-depth insights into the nature of the tasks. It was found that the results of both the questionnaire and interviews were, overall, in agreement on the frequency of the maximum number of engineering academic tasks.

As for the second research question (i.e. Are there significant differences in the participants' perceptions of tasks, which can be attributed to the specialty of department or year of study?), the findings, from the first statistical analysis by conducting a Kruskal-Wallis test showed that the participant groups based on the specialty of department, demonstrated significant differences in their responses to a small number of tasks. The significant differences were recorded on seven tasks only, while they exhibited unanimous agreement on the remaining 28 tasks. Despite these differences, no exclusive association could be established between a task and any one of the four departments. However, the statistics from the second Kruskal-Wallis test revealed that the participant groups based on the year of study diverged considerably in their responses to relatively a large number of tasks (12 out of 35 tasks). These differences were also discussed in detail in the previous section. It is just to add here that some of the tasks were found to have a closer association with one year of study than with another. For example, "graduation project report" is only related to 5th year, while "summer training report" is associated both to 4th and 5th years.

5. Conclusion and Recommendations

The main purpose of the present study is to identify the most frequent tasks engineering undergraduates carry out in English in their respective departments of engineering, and to prioritize the most common tasks based on the frequency counts for each department as well as the year of study. In response to the two research questions posited in the introduction, the results from the questionnaire indicated that overall 27 tasks were often carried out by the engineering undergraduates in their departments. However, the findings of the interviews revealed that some of these tasks did not demand much English proficiency to be completed successfully by the students. This is because some of the tasks are mostly based on numerals, symbols, diagrams, and formulas. Others are heavily supplemented with the use of Arabic. In both cases, the demand for English use is too limited to pose any challenge to the students to perform the task. Such tasks require students to focus more on problem-solution and less on spoken or written texts interaction.

Considering Brown's (2016) "*diagnostic view of needs*", the findings of the study also suggest that the needs of the engineering undergraduates are too broad and exhaustive to be covered in a one-year-long PY programme. Therefore, it is recommended that the current EAP/ESP syllabus of the PY should be reconsidered and restructured in light of the immediate and vocational needs of the leaners. The study also validates that all the four engineering departments have the same combination of academic tasks, as they are following the same learning objectives recommended by the ABET. Therefore, the existing ESP materials may be utilized to focus on only those language aspects or skills which are common to all engineering departments. Moreover, to ensure the PYP remains effective and relevant, the current teaching and learning materials should be tailored, and the pedagogic tasks/activities as well as the assessment setting should integrate the "frequent" tasks based on the finding of this study.

6. Limitations of the Study and Avenues for Further Research

However, this study has the limitation in generalizing its findings and recommendations to other Saudi public universities, as they are different in their institutional policies and language requirements for their engineering undergraduates. It appears that extending the needs analysis to other universities with a different milieu would have produced different results.

This study offered a holistic view of the target tasks the engineering students frequently perform at their undergraduate level. It would be interesting to find out how the students perceive the difficulty level of the tasks and how they use their acquired linguistic resources to handle such tasks. Additional research may shed light on the complexity or difficulty of tasks that place some more linguistic burden on the students. It would also be revealing to investigate the strategies the students would prefer to employ to deal with such challenging tasks.

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