

Application of Rasch Analysis in Exploring Communication Skills Among Engineering Technology Graduates in Malaysia

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ABSTRACT

In today's rapidly evolving work environment, graduates in engineering technology must continuously improve their general skills to remain competitive and relevant. A significant gap exists between these graduates' skills and the industry's expectations, particularly in communication. Effective communication is widely recognized as a key competency that significantly influences employability and overall success in the workforce. This study aimed to assess the communication skills of Malaysian engineering technology graduates through a comprehensive survey comprising of 61 items. 37 graduates, aged between 22 to 30 years, participated in the study and shared their perceptions of their communication abilities. To ensure the validity and reliability of the survey instrument, Rasch analysis was employed. The analysis demonstrated strong person reliability and separation values, confirming the survey instrument's robustness. Item reliability further affirmed the tool's adequacy, although two items did not meet standard fit indices, the items were retained due to their relevance to 21st-century communication practices and their contribution to overall reliability. These skills are crucial for graduates to navigate digital communication landscapes and adapt to technology-driven industries. The study's results provide significant insights into how these graduates' communication competencies align with industry needs, emphasizing the necessity of integrating advanced communication training into educational curricula. By equipping students with these critical skills, institutions can better prepare graduates to meet workforce demands, enhancing their employability and career progression.

Keywords: Communication skills; engineering technology graduates; survey instrument; employability; validity and reliability

INTRODUCTION

In the face of the new industrial revolution, engineering technology graduates must adapt by enhancing their generic skills to stay relevant in the dynamic work environment. Research highlights a significant gap between the skills possessed by graduates and those demanded by the industry, leading to challenges in employability (Harishee 2022; Mohd Kamaruzaman et al. 2019). Research indicates a gap between the skills developed during university education and those required by

employers, particularly in areas such as negotiation, presentation, and diplomatic communication (Rahman et al. 2019). This skills divergence extends to engineering graduates, who are expected to possess attributes like decision-making, problem-solving, and the ability to work in multicultural environments (Nair, Patil, and Mertova 2009).

Communication skills are increasingly recognized as essential competencies for engineering technology graduates, impacting their employability and effectiveness in the workplace. As the engineering field evolves, the demand for professionals who can articulate ideas clearly

and collaborate effectively has intensified. Employers now expect graduates not only to possess strong technical skills but also to demonstrate proficiency in various forms of communication, including verbal, written, and non-verbal skills. Various studies have emphasized the importance of communication skills alongside technical expertise in the rapidly evolving landscape of engineering (Nuralievna 2023; Kumar et al. 2022). Effective communication skills are crucial for 21st-century engineers' success in the modern workplace. The changing landscape of global communication, driven by factors like globalization and Industry 4.0, underscores the significance of communication abilities in engineering professions. Studies, such as Ismail et al. (2023), emphasize the growing importance of the 4Cs: communication, collaboration, creativity, and critical thinking as essential skills for engineering graduates. However, communication is often prioritized over creativity in engineering education, leaving a significant gap in industry expectations.

Graduates with strong communication skills are better equipped to meet the expectations of employers, who are increasingly shifting their assessment criteria from purely technical capabilities to a more holistic evaluation of graduates' competencies, including interpersonal skills and cultural awareness (Owusu-Ansah and Anane, 2024). Barot (2020) points out that current engineering curricula primarily focus on technical knowledge and skills, neglecting the development of communication abilities. This gap is significant as employers have noted a deficiency in communication skills among graduate engineers. According to research by Mohalley-Snedeker and Galfond (2022), there has been an effort to integrate communication abilities into engineering education. This involves substituting conventional laboratory experiment reports with alternative methods of communication, like research posters. The goal is to offer students additional choices for sharing their discoveries and conveying them to a wide range of audiences. Integrating student-centered tasks and activities that emphasize speaking skill has shown a significant improvement in communication proficiency among undergraduate engineering students, highlighting the positive impact of innovative teaching methods on language skills development (Setia 2023).

ENGINEERING TECHNOLOGY

The emergence of engineering technology education has become crucial due to the industry's demand for proficient technical personnel capable of applying technological

concepts, improving equipment and system utilization, and ensuring optimal operation and maintenance of equipment, plant systems, and structures to align with the workforce standards in developed countries (Yahaya et al. 2012). The initial introduction of engineering technology programs in public higher institutions in Malaysia occurred in the early 2000s when technical university colleges such as Kolej Universiti Teknikal Kebangsaan Malaysia, Kolej Universiti Tun Hussein Onn, Kolej Universiti Kejuruteraan Malaysia, and Kolej Universiti Kejuruteraan Utara Malaysia were established. These university colleges were later renamed as Universiti Teknikal Malaysia Melaka (UTeM), Universiti Tun Hussein Onn (UTHM), Universiti Malaysia Pahang (UMP), and Universiti Malaysia Perlis (UniMap) respectively, leading to the formation of the Malaysian Technical University Network (MTUN). MTUN's primary role is to nurture engineering technologists as outstanding outcomes of Technical and Vocational Education and Training (TVET). Additionally, private universities and colleges also offer engineering technology programs.

The Engineering Technology Accreditation Council (ETAC) in Malaysia has established the Engineering Technician Education Programme Accreditation Standard (2020), which emphasizes the importance of communication skills as part of the accreditation criteria for engineering technology programs. Graduates must demonstrate the ability to communicate effectively in both written and oral forms, which is essential for collaboration in multidisciplinary teams and for conveying technical information to non-technical stakeholders (Engineering Technology Accreditation Council, 2020).

RASCH ANALYSIS

Rasch analysis is a powerful tool available for evaluating and validating survey instruments. It provides insights into respondent patterns and item difficulty, allowing researchers to refine their measurement tools. Rasch analysis can assess data quality, reliability, and validity of questionnaires (Isa et al. 2017), as well as evaluate the fit of items to the measurement model (Anggraini et al. 2023).

The primary objective of this pilot study was to employ the Rasch technique in the analysis of a communication skills instrument intended for assessing the perception of engineering technology graduates regarding their skills. Furthermore, the study aimed to identify any potential weaknesses in the instrument and determine necessary improvements to enhance its effectiveness when used with the target population.

METHODOLOGY

SAMPLE

This study uses the convenience sampling technique as a baseline approach. Specifically, it involved analyzing the communication skills of engineering technology graduates. The respondents either had no work experience or had less than 5 years of work experience. The participants had graduated within five years from the time the study was conducted or were in the final semester of their studies. Table 1 shows the demographics of the respondents. There were 37 respondents who were engineering technology graduates aged between 22 and 30. The total number of male respondents are 23 (62%), and 14 are female (38%).

TABLE 1. Demographics of Respondents

Profile	Demographics	N	Percentage (%)
Gender	Male	23	62
	Female	14	38
Age	22-24 years old	5	13
	25-27 years old	24	65
	28-30 years old	8	22

INSTRUMENT

The survey used in the study has two sections. Section A included 6 demographic-related questions, while Section B focused on communication skills and comprised 61 items. The communication skills variables were measured using an instrument that was adopted and modified from the works of Almeida, Becker, and Villanueva (2019), Van Laar et al. (2018) and Kelley et al. (2019). Items were measured using a five-point Likert scale (1: Strongly Disagree; 2: Disagree; 3: Slightly Agree; 4: Agree; 5: Strongly Agree) to reflect the graduates' perception of their skills. Appendix A presents all the items used in this study.

DATA COLLECTION PROCEDURE

Primary data for this study was collected through a Google Form survey. The survey link was predominantly shared with the respondents via LinkedIn. Prior to participation, the respondents were provided with information regarding the study's purpose. It was emphasized that the gathered data would be used solely for research purposes, reported in aggregate form, and maintained in an anonymous manner.

DATA ANALYSIS

Researchers are attracted to the Rasch technique to validate and evaluate the effectiveness of constructed items for instrument development. The Rasch assessment approach was employed in this study to assess the communication competency levels of engineering technology graduates. Here, "persons" refers to the respondents, who are engineering technology graduates, and "items" refers to the communication skills being evaluated. The measurement standard "logits" was used to quantify the distribution of persons and items. The Rasch model enables the conversion of raw data while measuring individuals and items on a single scale. This is accomplished by plotting individuals and items on the same logit scale in a person-item map, also known as the Wright map. Based on Bond and Fox (2015), Rasch model enables researchers to identify items that respondents find easy to agree or disagree with and individuals with high ability who tend to agree with most items, suggesting that those with high ability find it straightforward to endorse the survey.

RELIABILITY AND VALIDITY INDEX

Reliability assesses the stability and consistency of measurements, while validity evaluates whether an instrument measures what it intends to measure (Mohajan, 2017; Kimberlin and Winterstein, 2008). Both criteria are essential for reducing measurement error and ensuring the accuracy of the data collected (Othman et al. 2014). According to Bond and Fox (2015), reliability values ranging from 0.81 to 0.90 are considered satisfactory, while those falling between 0.91 and 0.94 are deemed highly satisfactory. Values exceeding 0.95 are considered outstanding. When looking at the separation value, a value ranging from 3 to 4 is considered good, and a value between 4 and 5 is labeled as very good. Moreover, Linacre (2016) considers a separation value greater than 2 to be good.

As for item validity, the criteria that are applied are outfit mean square (MNSQ), outfit Z-standard (ZSTD), and point measure correlation (PTMEA). Table 2 presents fit indices used to assess measurement models based on Boone (2016). Point Measure Correlation (PTMEA-CORR) indicates the correlation between item scores and the overall measure. It reflects how well each item aligns with the underlying construct being measured. Values between 0.40 and 0.85 are considered acceptable. For outfit mean square (MNSQ), values between 0.50 and 1.50 are considered acceptable.

TABLE 2. Fit Indices for Item Validity

Statistics	Fit Indices
Infit and outfit mean square values (MNSQ)	0.50 to 1.50
Infit and outfit z-standardized values (ZSTD)	-2.00 to 2.00
Point Measure Correlation (PTMEA-CORR)	0.40 to 0.80

RESULTS AND DISCUSSION

RELIABILITY AND SEPARATION INDEX

The summary statistics for the items and responses (persons) are presented in Table 3. Cronbach's alpha is a statistical measure used to evaluate the internal consistency or reliability of a set of items within a survey or test. The value of Cronbach's alpha ranges from 0 to 1, with higher values reflecting greater reliability. In this study, Cronbach's

alpha value of 0.96 indicates highly reliable interaction between respondents and items. The instrument employed to measure the communication skills of engineering technology graduates has a high degree of consistency, as seen by the high level of Cronbach alpha values, and as such, it is accepted for use in this study.

The MNSQ, or mean square, is a chi-square statistic that calculates items fit within a measurement. According to Table 3, the data indicates that both the infit MNSQ and outfit MNSQ for respondents and items are close to 1.0, demonstrating an acceptable fit to the model. The respondent's reliability value was 0.94, signifying very high reliability, with a separation value of 4.04, suggesting a broad range of abilities among the respondents, allowing for classification into 4 groups. The instrument's reliability value of 0.78 suggests adequate and reliable for measuring the intended measurements. The item separation value was 1.88, and when rounded up is equal to two. These results show that the respondent's ability to answer the survey on communication skills can be classified into two categories.

TABLE 3. Summary statistics for respondents (persons) and items

	Respondent (Person)	Item
Measure		
Mean	1.46	0.00
SD	0.99	0.59
Outfit MNSQ		
Mean	1.01	1.01
SD	0.70	0.32
Infit MNSQ		
Mean	1.03	0.98
SD	0.72	0.31
Separation	4.04	1.88
Reliability	0.94	0.78
Cronbach Alpha	0.96	

Note: SD = standard deviation; Outfit MNSQ = outfit mean square; Infit MNSQ = infit mean square

ITEM MEASURE

The Rasch analysis model uses criteria such as point measure correlation (PTMEA), outfit mean square (MNSQ), and outfit Z-standard (ZSTD) to assess item validity. Figure 1 displays 11 items that did not meet the requirement within a designated range of fit indices (Table 2), indicating that the item needs to be reviewed for possible removal from the instrument or for amendment of the items. The item misfit is based on PTMEA values where 10 items are less than 0.4, and one item (item 16) is greater than 0.8.

Based on the MNSQ, the infit and outfit MNSQ value for item B49 falls outside the requirement of the 0.5 to 1.5 range. Meanwhile, item B50 has an outfit MNSQ value that falls outside the requirement range. For both items B49 and B50, the ZTSD was also found to be outside the requirement of the -2 to 2 range as the values exceeded 2. Items B49 and B50 were removed to improve the instrument's reliability. However, after the removal, item reliability decreased to 0.72 (Figure 2). Therefore, for this study, the decision was made to retain the two items.

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD	PTMEASUR-CORR.	AL-EXP.	EXACT OBS%	MATCH EXP%	ITEM
24	148	37	-.50	.27	1.34	1.37	1.38	1.52	.18	.51	59.5	59.7	B24
22	141	37	.00	.26	.97	-.04	1.07	.38	.18	.53	73.0	60.9	B22
23	139	37	.14	.26	1.02	.15	1.11	.53	.19	.53	73.0	60.6	B23
49	108	37	1.91	.22	2.11	3.85	2.20	4.03	.23	.61	32.4	49.5	B49
18	139	37	.14	.26	1.23	.93	1.27	1.11	.32	.53	54.1	60.6	B18
48	130	37	.72	.25	1.24	.99	1.30	1.20	.32	.56	59.5	56.1	B48
51	130	37	.72	.25	1.26	1.05	1.25	1.05	.32	.56	43.2	56.1	B51
2	159	37	-1.38	.29	1.38	1.60	1.35	1.51	.34	.49	64.9	59.9	B2
50	122	37	1.18	.24	1.54	2.06	1.61	2.24	.38	.58	45.9	52.4	B50
19	134	37	.47	.25	1.06	.30	1.15	.67	.39	.55	64.9	58.7	B19
16	139	37	.14	.26	.60	-1.81	.60	-1.81	.81	.53	73.0	60.6	B16

FIGURE 1. Item Misfit

ITEM	61 INPUT TOTAL	61 MEASURED COUNT	MEASURE	REALSE	INFIT IMNSQ	ZSTD	OUTFIT OMNSQ	ZSTD
MEAN	140.4	37.0	.00	.27	.98	-.1	1.01	.0
P.SD	8.8	.2	.59	.02	.31	1.2	.32	1.2
REAL RMSE	.28	TRUE SD	.52	SEPARATION	1.88	ITEM	RELIABILITY	.78

ITEM	59 INPUT TOTAL	59 MEASURED COUNT	MEASURE	REALSE	INFIT IMNSQ	ZSTD	OUTFIT OMNSQ	ZSTD
MEAN	141.3	36.9	.00	.28	.99	-.1	1.01	.0
P.SD	7.5	.2	.53	.02	.28	1.1	.30	1.2
REAL RMSE	.28	TRUE SD	.45	SEPARATION	1.61	ITEM	RELIABILITY	.72

FIGURE 2. Item Reliability Before and After Item Removal

PERSON-ITEM-MAP

In Rasch analysis, a Person-Item Map, also known as a Wright Map, is a key tool in Rasch analysis for survey instruments. It provides a graphical representation that helps visualize the relationship between respondent's abilities and item difficulties. The map shows the distribution of item difficulties along the vertical axis, with the easiest items at the bottom and the hardest at the top. Figure 3 shows the person-item map obtained from the Rasch analysis. The measure used is in logit. Person measurements range from logit -1 to logit -4, whereas item measurements fall between logit -2 and logit 2. People on the upper side have higher abilities compared to the people on the lower side. This result shows that most of the respondents showed adequate proficiency in these skills.

For the item, the upper side of the map features items with higher difficulty levels than those on the lower side. Although the items have a low separation level, which is a separation value of 2, the items represent the basic communication skills the graduates need to acquire during their studies. Most of the items on the map fall within the logit range of -1 to 1, indicating that they are relatively moderate and easy in comparison to respondent's abilities

in answering the survey. Based on Boone (2016), test items cannot be assumed to exhibit the same level of difficulty, and all items should not be assumed to be equally agreeable. For example, in this study, a B2 (strongly agree) in response to item B49 of a survey should not be assumed to indicate the same level of agreement as answering a B2 (strongly agree) to item B6 of a survey. Item B2 is the most agreeable item. "I believe the ability to communicate effectively is important for career advancement" shows that all graduates agree on the importance of communication skills for their career advancement. While item B6 "I make sure the message is completely understood" may also be agreeable by all respondents, but the agreeable rating given to item B6 would be less than B2. Meanwhile item B49 is the most disagreeable item would have disagreeable by most of respondents. Item B49, "I post a blog/article on the internet" may not feel relevant and useful skills perceived by graduates. Item B50, "I share information on the internet to start a discussion" also did not feel needed and was not practiced by the majority of respondents. Item B56, "I use my online network to generate business" is the third least frequent skill agreed by graduates, which might represent the graduates have less interest in entrepreneurship through online networking.

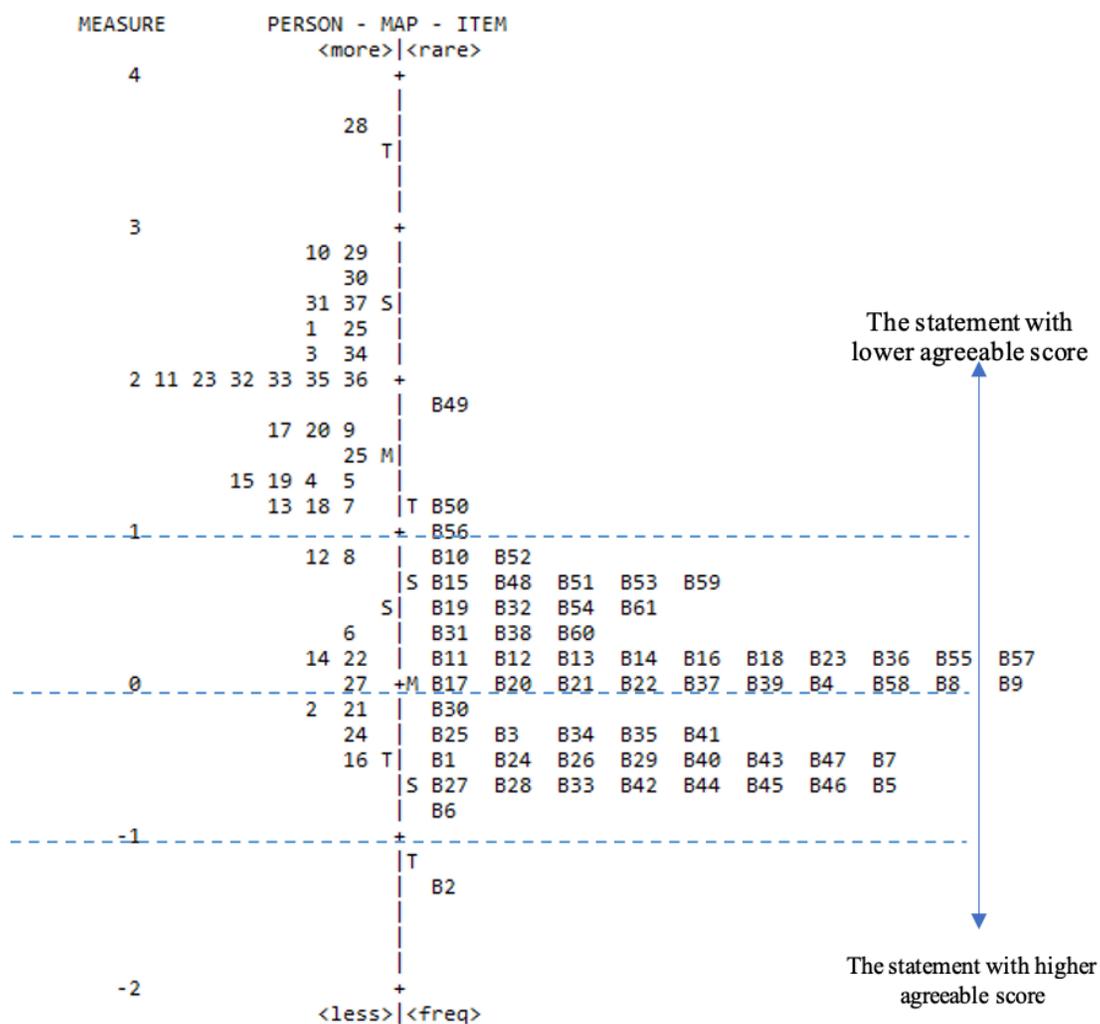


FIGURE 3. Person-Item Map

CONCLUSION

This study uses Rasch analysis to ensure the validity and reliability of the instrument used to identify the communication skills proficiency of engineering technology graduates. The instrument was developed to ensure that graduates are equipped with the necessary skills to join the workforce in the 21st century and advance their careers in industry. The analysis shows that the study has a very good value of person reliability and separation value. The item reliability value indicates that the instruments used are adequate and reliable to measure the communication skills of engineering technology graduates.

The results indicate that these graduates possess adequate communication skills, especially in aspects such as verbal clarity and effective information dissemination, which are vital for their entry into the workforce. However, the findings also point to areas that need further enhancement, notably in digital communication methods,

including blogging and starting online discussions. These skills, associated with the items B49 and B50, are becoming increasingly significant given the rapid technological progress and the digital transformation of industries. Although these digital communication skills are not as frequently practiced by graduates, they are essential for successfully navigating today’s professional landscape and improving job prospects. Including these items in the instrument highlights their significance in developing 21st-century competencies. The high reliability and separation metrics strengthen the tool’s validity in reflecting the graduates’ diverse communication abilities.

These results offer valuable insights into how well graduates’ communication skills align with industry standards, emphasizing the necessity of incorporating advanced communication training into engineering curricula. By addressing the gaps identified, educational institutions can more effectively prepare graduates to meet the evolving requirements of the modern job market, ultimately boosting their employability and career growth.

This study emphasizes the importance of reliable assessment tools and focused curriculum development in equipping graduates with vital communication skills for their professional success.

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DECLARATION OF COMPETING INTEREST

None.

APPENDIX A

No.	Item
B1	I can have face to face oral communication
B2	I believe the ability to communicate effectively is important for career advancement
B3	I am able to explain ideas clearly and concisely
B4	I am able to answer questions clearly and concisely
B5	I use simple and direct communication
B6	I make sure the message is completely understood
B7	I am able to use different tones depending on the situation
B8	I have the ability to communicate persuasively
B9	I have the ability to convince others on an idea
B10	I am confident in public speaking
B11	I actively participate in frequent update meetings
B12	I am able to speak clearly
B13	I am able to speak professionally
B14	I use a clear introduction and conclusion
B15	I created an interesting introduction and conclusion
B16	I present all information concisely
B17	I present all information logically
B18	I use appropriate body language when presenting
B19	I can communicate according to the audience
B20	I can communicate according to the purpose
B21	I can communicate according to the task
B22	I can communicate according to the situation

B23	I have the ability to select appropriate media to get the message across
B24	I use multiple types of mediums for communication, including e-mails, instant messages, text messages, phone calls, conference calls, presentations, and meetings
B25	I can translate technical information into messages that are understandable to non-technical audiences.
B26	I am able to write clearly
B27	I am able to write concisely
B28	I am able to write precisely
B29	I use email frequently for communication
B30	I can write different type engineering documents professionally including engineering requirements, technical specifications, design documents, manufacturing documents, work instructions, test reports, analysis reports, status reports, presentations, and all types of e-mails.
B31	I can write without miscommunication
B32	I can write without misinterpretation
B33	I proofread the written documents before sending
B34	I can organize information well
B35	I am able to communicate with the global workplace
B36	I am able to make connections with international suppliers
B37	I am able to make connections with international customers
B38	I have skills to successfully communicate cross-culturally
B39	I have sensitivity on the cultural differences
B40	I have respect on the cultural differences
B41	I am able to communicate appropriately with individuals from different cultural backgrounds
B42	I understand that technology has affected communication by increasing the speed of interactions
B43	I understand that technology has affected communication by increasing the volume of information
B44	I understand that technology has affected communication by increasing the number of emails
B45	I get what I want from interactions on the internet
B46	I can accomplish what I want via the internet effectively
B47	I know how to use the internet to express ideas clearly
B48	I post new messages on the internet
B49	I post a blog/article on the internet

B50	I shared information on the internet to start a discussion
B51	New collaborations emerge by approaching online contacts
B52	I establish online contacts to collaborate with
B53	I find experts on the internet to start a project with
B54	I put effort into online networking with people from my field
B55	I use my online network to benefit from it
B56	I use my online network to generate business
B57	I build online relationships with people from my field
B58	The internet helps me approach new professional contacts
B59	I use my online network to increase brand awareness
B60	I start a conversation with other professionals via the internet
B61	I use my online network to achieve policy goals

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