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Scientific communication: students' proficiency for workplace readiness

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ABSTRACT

Under the theme of "scientific communication proficiency for workplace readiness," researchers conducted this mixed-method study to specify key elements that improve student's proficiency for scientific communication and enhance the communicative competence in science, technology, engineering, and mathematics (STEM) for the students. Data were collected using questionnaires, in-depth interviews, and focus group discussion. The respondents and informants consisted of 351 STEM students, six STEM business executives, and three communication experts. The conceptual framework was designed based on a communicative competence model to identify relationship between skills, knowledge, and training history. The science communication model of existing core elements (CE) based on sender, message, channel, and receiver (SMCR) communication model was developed. The implication of the finding significantly escalates the practice of scientific communication. The study highlights the importance of considering different elements under SMCR in enhancing communication skills among STEM students. The expectations of business executives and communication experts' views and feedback provided empirical inferences that significantly support the outcomes in terms of the practical implication phase. Based on the findings, the science communication model with key elements for work readiness is redesigned as the final outcome. The results could imply to enhance communication skills in various industries.

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1. INTRODUCTION

All business world employers expect candidates to be able to communicate clearly and effectively [1]. Employers seek candidates who can effectively communicate in the workplace. From employers' perspectives in the science, technology, engineering, and mathematics (STEM), candidates are lacking verbal communication, which is one of the top five highest ranking employability skills [2]. Consequently, recruiters actively seek potential candidates among all professionals who can adequately present or communicate their project results, product advantages, company goals, and implementation of the goals [3].

The main objective of science communication for business audiences is to translate scientific and technical concepts into content that businesses can use and ability to convey ideas and information [4]. For marketing and business units is to add value to benefit the business's customers. Those benefits can be derived by the clients, and this helps increase company brand awareness [5]. Both verbal and written communication skills are listed and considered as a highly requested and important skills for success in the workplace [6], [7].

Good examples of the required communication skills can be drawn from businesses all over the world. One of these can be seen in the challenges of daily work at Konica Minolta. Their business approaches to deliver scientific communication to nonscientific audiences, especially its clients in the business world who are crucial and play major roles. Although some clients work closely with them and know the products and services very well, science communication that is presented in a corporate context to broader audiences should be considered in terms that are simple, precise, and concrete. Awareness of audiences' knowledge to ensure that data is conveyed in a balanced manner is essential for science communication to specific audiences. With more than 40,000 employees in 150 countries around the world, Konica Minolta is dedicated to improving its employees' individual skills, especially in terms of scientific communication, to create customer value for their approximately two million corporate clients from the entire world [8], another study was conducted on business requirements. A countrywide self-report survey in Thailand on the subject of "your best skills at the workplaces for new hires" within the career ready guide campaign in 2016 showed that communication skills, such as in presentations, were considered to be one of the three skills most in need of recent Thai graduates. The participants were 10,000 students from universities all over Thailand [9].

Pescante-Malimas [10] investigated employers' required skills and personal attributes demanded of communications graduates and found that communication skills, especially written or verbal communication skills, are strongly required and studied, and is one of the main reasons why job seekers are not hired. Enhancing combination of technical skills, subject knowledge, and soft skills for students prior to graduation is a vital requirement for industries [11], [12]. Salikhova *et al.* [13] studied the communication abilities of university students. The study revealed that students possessed moderate communication skills and that disparities exist between academic departments, assessment of curricula, and teaching strategies. Individual's own abilities, skills, attitudes, and motivations require learning mechanisms, grooming, and societal practices [14]. Level of communication skills of teachers and students have significant differences. However, students require intensive training in improvement of communication [15]. Nonetheless, many students avoid presenting despite being in their educational context in university, especially due to the ability to express verbally in front of public [16], [17].

As mentioned, communication skill is one of the most vital proficiencies after graduation, preparing students for the workplace and further discussing their readiness for getting into corporate world. Communication skills is one category among the four dimensions: i) analytical skills; ii) career professional skills; iii) personality; and iv) leadership and team/group work [18]. Both verbal and written communication skills are considered as significant standards competencies needed in various industries [19]. Without experiences in workplaces, students will have limit abilities of communication skills in variety situations [20]. The entire global trends on graduates' abilities research for workplace have been increasing significantly over years [21]. Although students' learning process in scientific communication skills has potential to increase [22], there were few communications for workplace studies, particularly in the learning and teaching of STEM communication, which gradually increased to meet the requirements and importance of the business and countries worldwide. Ishmuradova *et al.* [23] conducted a bibliometric study on science communication in STEM education in the Scopus database and found that the number of articles increased between 2019 and 2022. Communication, science communication, public understanding of science, science education, and STEM were the most frequently used keywords.

The relationships among perceptions of learning environment, engagement, and achievement had direct effects on skill development [24]. Teachers and students' alignment with requirements from industries forms imperative for the expansion of the industry. The constructive feedback received from business executives and communication specialists will be beneficial and useful for the improvement of communication skills [25]. Although students can train themselves to improve their fundamental skills, especially for communication [26], a training program with an intervention set of activities and feedback was recommended to improve students' communication skills [27]. According to Gador *et al.* [28], students could be given opportunities to be exposed to activities, to enrich their experiential learning in the university and feasibility in the workplace. To fit the needs and to match the actual experiences, communication curriculum should be revisited.

Science and technical presentation skills consists of three areas: the presentation skills and attributes, the language skills, and the non-verbal attributes. The presentation skills and attributes focus mainly on technical competency, audiences, creativity, and delivery; the language skills focus on complex terms and jargon; and the non-verbal attributes focus on norms, vocal variety, and eye-contact. Clarity of speech, language usage, and presentation direct to the audience are ranked as presentation criteria [29]. The audiences of science communication can range from individuals and groups or the world [30]. According to Sugito *et al.* [31], the knowledge presentation method can enhance the communication skill for teaching and learning science. Effective presentation is mentioned in many areas on career success [32].

The main theme of this research work is 'scientific communication proficiency for workplace readiness'. This study aims to specify key core elements (CE) that enhance scientific communication proficiency of STEM students for workplace readiness. The ultimate goal is to be able to enumerate and characterize the elements to initiate a training and workshop template that will enhance communicative competence in STEM and improve students' workplace readiness. The researchers examined kay activities to: i) determine communicative competence; ii) develop knowledge, skill, and training to significantly support students' proficiency for workplace readiness; iii) study how the existing CE from extant literature affect scientific communication proficiency; iv) identify any other concerns or required elements from business for new graduates; and v) establish a science communication model with key elements to support curriculum developers and students' developmental programs.

Elements affecting communication skills in this study were created using the well-known elements of communicative competence in McClelland's competency model: knowledge (K), communication skills (S), and attributes (traits and motives) (A). There are various mechanisms for skill development such as training programs that may be supplemented by a focus on acquiring knowledge from within the institute system and training program or by information sharing elsewhere among peers: this has an indirect effect on skill development. When individuals or groups perceive tasks that require skill, they are likely to utilize their knowledge or resources [33]. The communicative competency of skill in this study refers to the ability to communicate scientific matters with either scientific or non-scientific audiences at the workplaces.

A conceptual framework for the factors affecting communication skills in this study was designed as shown in Figure 1. Communication skill as one of key elements in communicative competence, a dependent variable that has a direct effect from the two key independent variables: knowledge and training, Impactful communication skills and students' proficiency would be high or low depending on the independent variables. To deliver messages and content successfully in scientific communication, STEM knowledge is highly required to be termed as specialist in particular areas. As communication skill is a vital soft skill either for business or personal communication, training is the most necessary variable, with a particular emphasis on practice and rehearsal prior to delivering key messages to audiences. Grade point averages were used to represent with reference to results from the disciplines that STEM students were studying in their departments. Self-efficacy (SE) plays important role to students' workplace readiness [34]. SE has significant relationship and strong impact to communication skills [35]. Speaker SE and confidence in public speaking have a significant influence on self-assessment of verbal presentation competence [36]. Here, skill was measured by the ability to perform a certain task that represented perceived SE in communication skills. Motive was noted, understood as the need for achievement and how people pursue success. People can be trained or developed to have the competences they need. Hence, in this study, the traits and motives listed under attributes in McClelland's model, regarding internal drive, were coded as CE of communication competence [37].

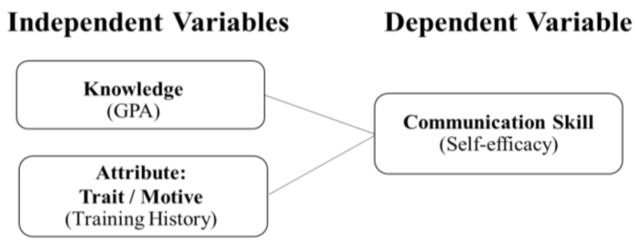

Figure 1. Conceptual framework for the factors affecting communication skill

Mercer-Mapstone and Kuchel [38] studied science communication and teaching within a course for the Australian Bachelor of Science degree. Their study provided 10 CE for curriculum development in science communication to communicate with non-scientific audiences. These elements included audience, language (jargon), purpose, prior knowledge, mode, content, context, style, engagement, and narrative. These CE were illustrated in Berlo's communication model, the sender, message, channel, and receiver (SMCR) model [39], [40] as shown in Figure 2. This conceptually designed model was considered as a guidance for the development and use of communication skills in this study. The elements of purpose, audience, and the audience's prior knowledge were allocated in audience-centric consideration for audiences as receivers.

Elements for context, content, language (jargon), and engagement were allocated to communication message design for audiences. Elements for style, mode, and narrative were allocated in communication styles. Students, as a sender to communicate with either scientific or non-scientific audiences as a receiver, have to consider on getting to know the audience, consider the levels of prior knowledge in the target audience, and identify right purpose and intended outcome of the communication for the audience. To define key message, sender has to use appropriate language for the audience, including factual content that is relevant to the audience to understand for the outtake, considering the context of the science being communicated, and present the information in and engaging context using style elements such as humor, anecdotes, metaphors, and imagery. The sender has to use a suitable mode and platform to communicate with tools of storytelling and narrative. This figure is a conceptually designed model for the method of this study. The following research questions were set: i) Do the relationship between STEM knowledge (GPA), skills, and training history are significant to support students' proficiency for workplace readiness? (RQ1); and ii) what is the essential CE affecting science communication skills in STEM undergraduate students to support their workplace readiness? (RQ2).

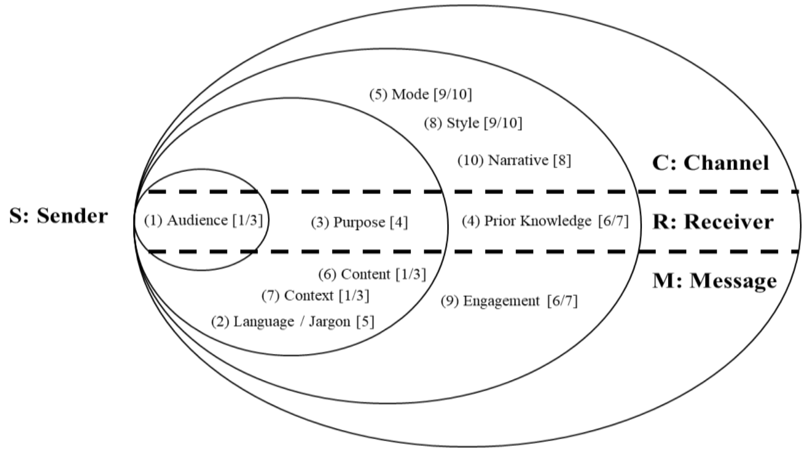

Figure 2. SMCR communication model with CE for effective science communication skill

2. RESEARCH METHOD

2.1. Population and sample groups

The study defined three groups of respondents and informants, selected using purposive sampling. The first group was STEM students. In Fletcher and Tan findings [41], students should test out potential career paths through internships to learn how to be ready to become employees in their career fields. Communication skills have been improved after the internships and secured student's workplace ready [42]. The participants in this first group then were STEM students who had communication skills and experience with scientific and nonscientific audiences in their internships. The second group was STEM business executives who recruited STEM graduates. The third group was communication experts who led communication trainings for business.

2.2. Questionnaires

The questionnaire had three parts. Part I collected personal data and general background information. Part II collected information on perceived SE regarding respondents' experiences with relation to a list of core skills for communication used by Mercer-Mapstone and Kuchel [38] for science communication to nonscientific audiences, as well as other relevant soft skills. Part III consisted of open-ended questions for the respondents to share their concerns with respect to science communication skills, achievement their career goals, and their experience of communication skill practices. To collect perceived SE information, a 5-point Likert-type scale was used.

After the questionnaire was developed, it was translated into Thai and sent to five experts for a ranking system check of index of item objective congruence (IOC) before dissemination. Questions with an IOC score of 1.00 were used in this study. Once the online questionnaire was finalized, it was distributed for testing. The survey questionnaires were disseminated for a trial with 130 students studying in a STEM program. The Cronbach's alpha values for the SE assessment on skills and effective CE were higher than 0.90, which indicated excellent reliability.

The questionnaires were developed and sent to 340 STEM students with a consent form. The quantitative survey method used in the questionnaires was intended to identify how the respondents applied their communication competence and knowledge in communication skills. To identify the relationship between STEM students' SE in communication skills, knowledge, and communication competence and to identify CE affecting communication skills for STEM students, the list of SE items and CE items in the SMCR communication model were developed. Cronbach's alpha values for all constructs in the questionnaire were higher than 0.80 as shown in Table 1, which indicated adequate internal consistency reliability of the questionnaire.

Table 1. Coefficients of the SE assessment and the CE (n=340)

	Cronbach's alpha	N of items
SE	0.952	12
CE_sender	0.834	5
CE_mess age	0.858	5
CE_channel	0.828	5
CE_receiver	0.904	5

2.3. In-depth interviews

The other preliminary method was the in-depth interview, which was used to accumulate factors and concerns from the participants regarding science communication skills. The questions provided were: i) do you have any concerns as new graduates (for business representatives: with new graduates) to communicate with nonscientific contacts or customers in business?; ii) have you had any difficulty in delivering science content with your staffs or customers?; iii) do you have any suggestions for how to develop science communication skills to support your current business expectations?; iv) do you have any recommendations for technological support in science communication (presentation) skills?; and v) do you have any other skills that could enhance your staff's competence in science communication? This list of questions was developed in Thai and was sent to five experts for an IOC ranking system check before implementation.

The informants in the in-depth interviews were six STEM students who had done internships, three executives at STEM companies, and one expert in communication training. We chose the post-interns due to their real-world work experiences and skills that can prepare them for a readiness in business points of view [43]. The interview method was used to explore how students applied their communication competence and knowledge in their communication skills and to determine any concerns or barriers in terms of science communication and suggestions for improvement. The interviews were using phone interviewing. Each call took 15–20 minutes. The records were transcribed, analyzed, and described in narrative form using coding and quotations.

2.4. Focus group discussion

This instrument method was adopted to confirm the finding of results from the survey questionnaire and the in-depth interviews. The informants in the focus group discussion consisted of five STEM students who had completed internships, three STEM business executives and owners, and two experts in communication training. This range of participants was selected to explore factors that cause poor communication skills and make suggestions for improvement. Three rounds of the discussion were held, with the following three questions: i) what concerns and barriers arise in communication with nonscientific audiences?; ii) what are the key elements that enable effective communication skills?; and iii) how can communication skills be improved and enhanced? Each round took 15–20 minutes. The records were transcribed, analyzed, and described in narrative form using coding and quotes.

Before the study was launched and data were collected, institutional review board approval was obtained with reference to human research ethics (Refer to KMUTT-IRB-COA-2019-029). The survey questions and assessment forms were developed and sent to five experts to perform IOC ranking system checks for validity before dissemination. Questions with a score of 1.00 were used in this study. Written informed consent was obtained in each case before the study was begun.

Statistical analyses were performed for data obtained from quantitative data using IBM SPSS version 17 (official version). Descriptive statistics and frequency were used for quantitative data finding. The qualitative data were interpreted by transcribed and analyzed from the open-ended questions, the audio recordings of the in-depth interviews and the audio and video records of the focus group discussion. The data were described in narrative form with coding and quotations. The findings were analyzed using 10 CE for effective science communication of Mercer-Mapstone and Kuchel [38]. All data were anonymized following the terms of voluntary noted in the consent form.

3. RESULTS AND DISCUSSION
3.1. Questionnaire

There were 203 (59.7%) females and 137 (40.3%) males in the group of STEM student respondents. The completed questionnaires included responses from 306 (90%) students in science, 26 (7.6%) in technology, and 8 (2.4%) students in engineering. In all, 184 (54.1%) students were trained on how to communicate via presentation, while 91 (26.8%) students were trained more than once. In addition, 122 (35.9%) students preferred to be trained. The results showed that 282 (82.9%) students indicated that they need training.

3.1.1. Do the relationship between STEM knowledge (GPA), skills, and training history are significant to support students' proficiency for workplace readiness? (RQ1)

The Pearson correlation coefficients in Table 2 showed significant correlations between key variables ($p<0.01$). The results addressed RQ1. Skill was correlated with training history and knowledge at r=0.188 and 0.145 respectively. Positive r values indicate that skill increased with training history as well as knowledge. Low r values indicate only a weak correlation among the three factors of interest.

Table 2. Correlation of communicative competency (n=340)

Pearson correlation	Communication skill	Knowledge	Training history
Communication skill	1		
Knowledge	0.145**	1	
Training history	0.188**	0.163**	1

**p<0.01

Students' SE assessments for communication skills, knowledge, and CE in communication competence were correlated positively, as identified with Pearson's correlation coefficient (Table 3) and linear regression analysis (Table 4). According to Table 3, there were significant relationships between the SE assessment of communication skills and all four categories of CE, including sender, messages, channel, and receiver ($p<0.01$). Knowledge and specific skills were positively correlated with SE assessment for communication skills ($p<0.05$), along with CE on the messages ($p<0.01$), and CE for the channel ($p<0.05$). The correlations found between knowledge and sender and knowledge and receiver in this study were not significant. Table 4 shows the results of the linear regression analysis, indicating the value of the standardized regression coefficient and its level of significance. The analysis was carried out to explore the relation between SE and CE of SMCR from STEM students. The R-squared value (R2=0.590) indicates that the independent variables (SE) explained 59% of the variance in the dependent variable (CE). The CE of SMCR, specifically for sender (β=0.282, t=4.555, $p<0.001$), message (β=0.260, t=3.868, $p<0.001$), and receiver (β=0.203, t=2.970, $p<0.01$) have significant positive impacts on the SE assessment of the presentation skills of STEM students. The CE for channel (β=0.095, t=1.351) does not have a significant impact on the SE assessment of presentation skill in this study.

Table 3. Mean and correlation between SE and the CE (n=340)

	SE	CE-sender	CE-message	CE-channel	CE-receiver	Knowledge	Scores M	Scores SD
SE		0.710**	0.710**	0.677**	0.697**	0.134*	3.07	0.84
CE_sender			0.777**	0.731**	0.771**	0.085	3.48	0.68
CE_message				0.805**	0.763**	0.175**	3.26	0.73
CE_channel					0.820**	0.126*	3.15	0.78
CE_receiver						0.096	3.33	0.75
Knowledge							2.45	1.02

*p<0.05, **p<0.01

Table 4. Regression analysis for the SE and the CE (n=340)

Dependent variable / Independent variables	β	t	R^2	ΔR^2
SE			0.590	0.586
CE_sender	0.282	4.555***		
CE_message	0.260	3.868***		
CE_channel	0.095	1.351		
CE_receiver	0.203	2.970**		

*p<0.05, **p<0.01, ***p<0.001

3.2. In-depth interviews and focus group discussion

3.2.1. What are the essential core elements affecting science communication skills in STEM undergraduate students to support their workplace readiness? (RQ2)

The resulting list of CE in science communication by executives, experts, and students are shown in percentage terms in Table 5 using the CE for effective science communication described by Mercer-Mapstone and Kuchel [38]. The summary results from the in-depth interviews and the focus group discussion significantly filled the gap from the questionnaire. The successful delivery of technical terms to nonscientific audiences and the CE affecting communication skill were discussed. The top ranks from business in communicating with the audiences were identifying and understanding target audiences, with the purpose/goal/objective and intended outcome of the communication. Business concerns with respect to the language (technical terms) that is appropriate for the audiences and the content that is relevant to audience's interests under the context of the scientific information, social, and culture. On the contrary, students focused on style elements for the mode of communication, such as humor, analogy, anecdotes, rhetoric, metaphors, body language, images, eye contact, and diagrams rather than focusing on audience-centric style. They were concerned with language (jargon) during presentations and at work but not in the preparation process. However, experts also recommended focusing on audience-centric communication and levels of prior knowledge in the target audience prior to design key content in any context and promoting audience engagement with the scientific content.

Table 5. Concerns in science communication using CE (n=20)

Communication CE reference words	Business (n=6) %	Expert (n=3) %	Student (n=11) %
Audience	100	100	0
Language (jargon)	92	67	64
Purpose	100	33	0
Prior knowledge	50	100	36
Mode	42	67	55
Content	92	100	36
Context	92	100	0
Style	42	0	91
Engagement	50	100	9
Narrative	50	33	27

This study was motivated by the need to enhance STEM students' communication skills to support the competences that businesses require or desired skills as with those highly recommended [9]. The constructive feedback that the student participants received from the facilitator, business executives, and communication experts were reported to be very helpful and useful for improvement in communication skills as indicated by all the students in the interviews [25]. The finding also indicates that although the students mainly focused on general speaking or academic abilities and were not well prepared for communication at the workplace [26], they still mentioned that they always avoid presenting in public and would rather prefer to be behind the scene, even though it is in their class in the university [16], [17]. For workplace readiness, both writing and speaking skills are in high demand, either from the students themselves or in respect to curriculum design, so practice to support this requirement is critically recommended.

In this study, the relationships between STEM students' skills, knowledge, and attributes (training) were found to be strong; hence, the results could support workplace readiness with a high degree of accuracy. The knowledge presentation with essential CE can enhance the communication skill ability [24]. Before graduating, it is strongly recommended that the required training in STEM communication be completed in order to meet the increasing demands of industries and meet their career challenges [17]. An intensive training and developing communication competence of teachers and students is needed [15]. Previous study [23] found that the majority of college students possessed moderate communication skills, and the present study's results support the need to evaluate curricula and teaching methods in light of their findings. However, their studies suggested that most social media platforms have little effect on communication skills, whereas our informants and participants in relied heavily on online information and platforms for preparation and practice. Therefore, additional research on media and online platforms is suggested.

Business leaders shared the barriers that they encountered in terms of communication skills were lack of business knowledge, lack of confidence, inability to come to the point, and inability to deal with people. Language barriers are among the key concerns because most organizations are focused on regional and international approaches. Hence, all internal and external communication materials and channels are in English. These include communication contents as well. One interesting point that a participant made was "*They don't know what they really don't know*," which was confirmed by a business executive's perspective on the workplace. This leads new employees to struggle with how to communicate well with others. Hence, it is highly recommended to provide opportunities for students to expose to activities to enrich their experiential learning that match the actual experiences in the workplace [28].

Our communication methods and channels were disrupted and evolving. The public's interest in science communication and science education should be more global and guided by a globalization strategy. Future research areas may consider and collaborate closely with business to ensure that STEM students are appropriately groomed and prepared for the workplace. Meanwhile, many of the elements and factors found in this study may spark an increase in the number of research articles published in science communication. We anticipate more database in international journals [16]. Without taking training course on purpose, they looked for free templates on general website and used them for their presentation guidance and self-development. Some of them used video clips, pictures, info-graphic, 3D pictures, and animations as medium tools and in their slides presented in full text for reading. Active presenters used games and activity base to draw audiences' attention. They designed and changed the tone of presentation to activities and set up games and to make it more audience centric.

As indicated in the results, anxiety is one of the key concerns that the respondents and informants noted with respect to their failure in communication. The finding from respondents and informants in this study research significantly expressed students' difficulties and anxieties to deliver some scientific terminologies to audiences with or without scientific knowledge/background in their regards in various situations or in public. Those who wanted to improve their skills asked for feedback after the presentation. They performed good gesture, eye contact, and deep breathing exercises to manage the stage fear and anxiety. These practices were from instructor's feedback in general education class, such as problem-solving class and community class, which is related to the general activities that support their self-confidence to speak in public. The training program should be designed with a series of intervention activities to improve students' communication skills and reduce their anxiety too [27]. Curriculum developers may wish to consider not only including the CE from this finding but also providing more activities rather than only lectures and text.

Nonetheless, while we are focusing on pure academic skill improvement, there remains some outstanding feedback from key informants in STEM that conflicts with extant research and has never been addressed. Required business skills include knowledge in the areas of business protocols, people-oriented, interpersonal communication, public relations communication, and sales and marketing communication apart from day-to-day problem solving, leadership, and product knowledge. Many businesses prefer to see how their new employees can blend their scientific knowledge and academic skills and attributes into their business traits and dilemma professionally and deliver information to diverse audiences fluently. These outcomes brought us to a strong consideration to the potential impact to groom students in more business-wise behavior rather than strictly focus on academics. Their external outreach proficiency would improve their employability, work readiness, and future career success. The STEM communication model with key elements for the workplace then is re-designed as a final outtake according to the findings from business requirements and concerns in this study as presented in Figure 3.

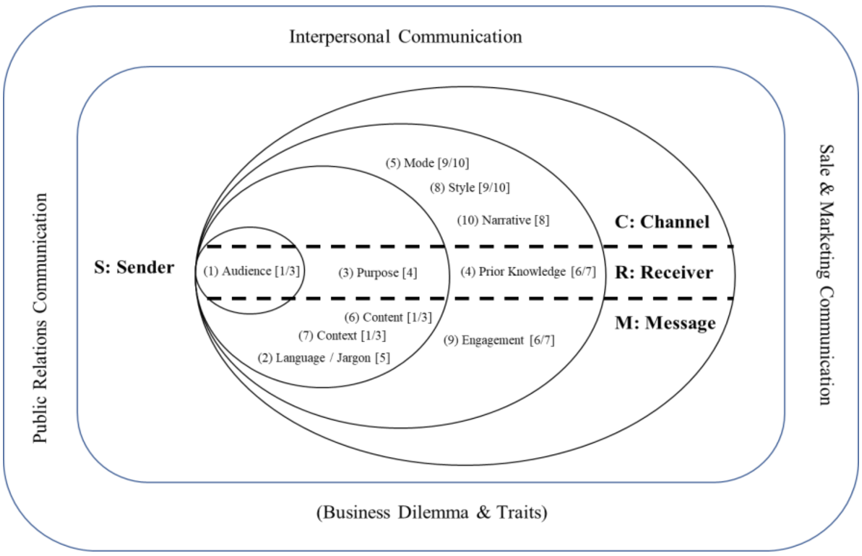

Figure 3. STEM communication model with key elements for workplace

4. CONCLUSION

This study highlights the importance of considering the different elements under SMCR in enhancing presentation skills of STEM students. The implication of these finding will significantly improve the practice of scientific communication. The interpretation of the findings supported the communication competence model of skill, knowledge, and motive by its correlations. The results can be interpreted to bear on individuals' practice or provide significant and practical implications for STEM students' achievements in their career paths, no matter whether it is at the workplace or in their personal lives leading to success. The relationships of the learning environment and engagement after the internships had direct effects to the skill development. The results of this study can enable STEM students to better prepare focusing on essential CE, i.e., audience centric, purpose, content, context, and engagement, to become workplace-ready after graduation in various types of STEM business, and support academics in their curriculum design as well.

Based on the finding, the presentation subskills on audiences' needs, objective, and impactful manner are recommended for effective professional presentation. It is recommended to provide pre-assessment for general knowledge, tacit knowledge, and competence assessments in relation to business expectations for STEM students prior to modifying and developing practical training modules for students. It would be interesting for future research to see how far the findings from this study can be replicated in other contexts, both in different cultural contexts and across countries. Science communication skills with generational impacts and the required competences for the coming century may be a subject of our future study. One significant quote by a leader in the STEM business section in this study was "It is found that students who had poor grades and performance but participated in many club activities did a good job, fit in with a group of people, understood the job, and worked well." It will be interesting to know whether we could learn what activities could support STEM students' communication competence and how this occurred. The bottom line of this study and its primary outtake is to review, examine, and explore best practice among academics, business, students, and teachers to meet business expectations, the ultimate goal of this work is to help improve STEM students' workplace readiness and strongly enhance their career success.

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