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A Systematic Review of Research on Pedagogical Practices for Communication Skills in Engineering Education

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Abstract : The authors carried out a review study on the pedagogy for teaching communication skills (CS) in engineering higher education institutions with a view to firstly present the trend on the instructional pedagogical approaches used in an engineering classroom and secondly, to show the impact of these approaches on learners' development of CS. In order to address the research questions, we adopted 'Systematic Literature Review' as a research methodology and reviewed empirical research studies published between the year 2001 and 2021 exploring electronic database. Having followed the review protocols, we finally selected 26 research articles for a detailed analysis and synthesis. In regard with number of publications, the trends placed the USA at the top position which was followed by India. Overall, we found a lack of experimental research, subsequently a lack of evidence-based teaching practice, in the domain of pedagogy for developing CS leading to the assumption of still prevalent conventional lecture method of teaching in the CS classroom which is further held responsible for poor CS among engineering graduates. The teaching trend indicates that engineering institutions across nations are increasingly becoming aware of evidenced-based teaching approaches and are adopting innovative, learner-centered methods blended with ICT tools to facilitate the process of developing CS, along with other generic skills which has positive impact on learners' development of skills and attributes. The findings have implications for both; research and classroom teaching.

Keywords : communication skills; engineering education; instructional pedagogy; systematic literature review.

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1. Introduction

The engineers of 21st century must be equipped firstly to deal with increasingly complex engineering problems, secondly to work in a multi-disciplinary collaborative work environment, and lastly to adapt to the changing requirement of employers (Samavedhan & Ragupathi, 2012). In order to meet with these evolving challenges of the workplace, engineering graduates need to possess not only technical knowledge and skills, but generic skills as well. The studies in the past have confirmed that the stakeholders of employability realized the indispensable role of generic skills and attributes in a collaborative work environment to produce desired

output at the workplace which in turn yields manifold satisfaction for customers, employers, and employees (Choi, 2013; Markes, 2006; Suarta et al., 2017). In this regard, research anonymously agreed that English CS is the one skill that has always been inevitably in demand as it is a pre-requisite to perform efficiently both in academics as well as at workplace (Labun, 2011; Missingham, 2006; Nutman, 1987). Baren & Watson (1993) in their article asserted two-fold benefits of developing CS which not only help students to be an effective communicator but also sharpen their thinking ability and subsequently improve the quality of thought process in the content of disciplinary subjects. Considering students' perception, Grahame & Keyvani (2019) in an experimental study revealed that students realized the value of communication through different modes of expression (oral, written, and graphical) that made them better team players and allowed them the flexibility to interact with a variety of audiences. Besides that, the need and usefulness of CS by the employed engineers was also confirmed through survey-based research conducted in Malaysia by Kassim & Ali (2010) which revealed that having an optimum level of command of the English language would greatly increase their chances of becoming global engineers, advancing their careers, and improving their professional aptitude at work. 21st century has witnessed the shift in perspectives of the stakeholders of employability towards generic or soft skills which has pushed CS to the forefront of the skill requirement as a result of which the possession of it has undoubtedly rendered its benefits primarily to the students and to the other beneficiaries too. As long as the need of CS for career is concerned, according to Aviv (2007), speaking abilities are a key factor in getting a job, which is why American institutions offer public speaking courses to help students hone their abilities. Similarly, Pollack-wahl (2000) considered oral presentation skills the most influential for students' success in their career. Seeking multiple stakeholders' perspectives, an empirical study echoed the perception of the recruiters, teachers and engineering students who unanimously agreed upon the importance of soft skills for employment which was significantly rated higher than hard skills, thus confirming the advantage of soft skills for career growth and progression (Willmot & Colman, 2016b). Excellent CS benefits professional engineers in international projects which expect them to work in a cross-cultural work environment and deal with problems and conflicts (Morreale et al., 2000). Moreover, research also highlights the value of CS from the perspectives of administrators and academicians in order for the students to succeed on the job advancement ladder and integrate into firms' competitive work environments (Gray, 2010 as cited in Kakepoto et al., 2012). As it is quite evident that the existing literature is abounded with the studies highlighting English CS as the need of an hour, there is a marked shift from merely focusing on technical skills to developing generic or professional skill, specifically CS in higher educational institutions (HEIs). Technical HEIs, being primary agency responsible to train engineering graduates, have revamped the curricula to incorporate the requirement of developing CS. The same is also looked after by some industries in the form of on-the-job training. Despite this development and the recognition of the critical importance of soft skills, CS continues to be perceived as "a lacking skill" among engineering students and recent graduates (Donnell et al., 2011; Ford & Riley, 2003; Jennings & Ferguson, 1995; Zainuddin et al., 2019) which consequently adds to a chronic issue of low employability. There are multiple reasons for poor communication, attributable to various aspects of engineering education such as lack of trained professors, heterogenous class, focus on syllabus completion, more importance on written exams, irrelevant syllabus design, and lack of relevant teaching-learning methodologies (Clement & Murugavel, 2015). This is further supported by research in engineering education that has also highlighted loopholes in training students for professional practice required at workplace (Male & King, 2014). Since “teaching” is considered to be the main activity in academia, the existing gap between “what is taught in the classroom and what is required at workplace” has highlighted the issue of poor pedagogy in engineering education. The vast amount of scholarship on pedagogy for teaching-learning CS lacks experimental/interventional studies which otherwise could be used to measure the effects of teaching-learning methods systematically and scientifically on the students' learning. And therefore, this lacuna in research evidently posits a concern about the “effectiveness and suitability of instructional pedagogy for skill development.” In that case, the efforts however being put to ascertain the same do not seem to yield the desired result because of which the shadow of poor communication still looms large in the classrooms, interview halls and at the workplaces. Therefore, it is required to practically investigate into the effectiveness of pedagogical approaches adopted to develop CS. Before plunging into the experimental study to measure the impact of a

particular instructional method on learners' CS, the authors felt the need to probe into the existing trends in classroom pedagogical practices which they think will spearhead their further research. Following this line of thought, this research article intends to carry out systematic literature review (SLR) on pedagogical practices for developing CS. Formerly, a few systematic review studies on the pedagogy for engineering education have been documented (Zainuddin et al., 2019)but there is a dearth of review study that reports the effectiveness of pedagogical practices for the development of CS among engineering students. Moreover, this study is novel in terms of the research methodology adopted because no SLR has ever been used to report the pedagogical trends in teaching-learning CS across the nations as well as to measure the impact on learners' outcome. Hence, based on the selected empirical research studies, the overall aim of this review study is to present the pedagogical trend prevailing among engineering institutions and further to report the effectiveness of these teaching-learning methods on students' learning outcome, particularly on CS. The findings have multiple implications: adding new findings to the current state of knowledge on teaching learning pedagogy for English/communication skills; carrying out research on measuring the effectiveness of a particular teaching method in a specific context; using any of the "tried and tested method" to teach in a particular setting. The remainder of this paper is organized as follows: In section 2 we outlined research methodology and research questions. Section 3 presented the results and in section 4 we addressed the research questions. Section 5 outlined impact of the study, limitations, implications, and conclusion of this study.

2. Methodology

A crucial component of research is doing a review of the relevant literature. Reviewing primary research to determine how well an intervention is working requires a methodical, scientific, and trustworthy evaluation procedure and a SLR aptly serves the purpose. According to Yang et al. (2020), SLR, in contrast to a broad literature review, uses a well-defined process to locate, evaluate, and interpret all relevant data pertaining to a particular research issue or questions in a manner that is as objective, trustworthy, reviewable, and repeatable as is practical. In regard with engineering education, SLR has the potential to support engineering education research by "uncovering patterns, connections, relationships, and trends across multiple studies" (Borrego et al., 2014 pp.46). It helps the reviewers to measure the interventional efficacy on a particular population (Baumeister & Leary, 1997) and verify the uncertainty about the effectiveness of a policy or service (Petticrew & Roberts, 2008). In addition to it, it helps in identifying any gap in current research and provide suggestion for additional research (Kitchenham, 2004). The purpose of this review study entails these functions of a SLR. This review study is undertaken to systematically identify, evaluate, and interpret the findings of 26 primary studies in order to address research questions pertaining to uncover the trends as well as an effectiveness of pedagogical approaches. Considering the review protocols, we concentrated on the aforementioned studies and followed their guidelines to design the methodology of this SLR.

A. Research questions

To structure the research questions for SLR, we adapted PICOC framework proposed by Petticrew & Roberts (2008) which helps to ensure that relevant parameters are defined in research questions. The criteria to be considered before conducting the SLR are population, intervention, outcomes, and context as can be seen in Table I. This study includes all the empirical studies which investigated the impact of different teaching-learning methods on the development of students' CS. Based on the PICOC structure, the research questions (RQ) are framed which are as follow:

1. What is the trend in research in pedagogy for CS in engineering education in 21st century?
2. Which approaches/methods are used in engineering classroom to teach CS?
3. What is the impact of instructional pedagogy on the development of CS?
4. What is the learning outcome?

Table 1 : Summary of PICOC

Criteria	Description
Population	Undergraduate
Intervention	Pedagogy
Comparison	None
Outcome	Skills developed
Context	Engineering Education

B. Search strategy

For information retrieval in this study, we targeted research studies which focused on pedagogical intervention to enable engineering students to acquire CS. (i.e., journal articles and conference proceedings published between the year 2001 to September 2021). The rationale behind choosing this time frame is rooted in the fact that the supply and demand for engineering professionals have changed radically in the 21st century, which has led to changes in how engineering undergrads are trained at HEIs. In this line, the transition is described in the literature in terms of a set of skills that engineers are required to develop and demonstrate in addition to their disciplinary knowledge (Reimer, 2007; Jabarullah & Hussain, 2019). Hence, reviewing the research conducted from the beginning of the century will make the present study relevant to the need of both industry as well as HEIs.

In order to search for relevant studies, we followed the approach used by Tenorio et al. (2016). The following keywords and their related cognates were used in the electronic database to locate potentially relevant studies:

1. Pedagogy OR pedagogical approach OR instructional pedagogy OR teaching-learning methods
2. Developing communication skills OR improving communication skills OR teaching communication skills
3. Pedagogical intervention OR pedagogical innovation
4. Communication skills OR English communication skills OR language competency
5. Engineering students OR engineering under graduates
6. Communication classroom OR engineering classroom

Then we used these key words and their synonyms in the following pattern:

(1 OR 2 OR 3) AND (4) AND (5 OR 6)

Finally, we inserted the proposed search string in the following databases to search the research articles.

1. Subject specific databases Education: ERIC, Education Full Text (EBSCO), IEEE Explore
2. General databases Academia.edu, JSTOR, Scopus, Google scholar
3. Journal databases Science Direct, Wiley.

C. Selection criteria

In this step, the studies have to meet the selection criteria (inclusion and exclusion) to be included in the systematic review (Kitchenham, 2004). The inclusion criteria are empirical research published in peer-reviewed journals from 2001 to Sept 2021. On the other hand, exclusion criteria are non-empirical studies, intervention not aiming at CS and for engineering students, short research, work in progress research, duplicate studies. Following are the inclusion exclusion criteria.

1) Inclusion Criteria

1. Empirical research on the impact of instructional pedagogy on the development of CS
2. The study reports quantitative, qualitative as well as both for measuring effectiveness of a method/an approach
3. Participants of the study are under graduate engineering students of face-to-face mode of learning
4. Published between the year 2001 to September 2021 in a peer-reviewed journal or conference proceedings indexed in high ranked journals

2) Exclusion criteria

1. Conceptual or perception study
2. Intervention not aiming at engineering undergraduates
3. Intervention not aiming at developing CS
4. Work in progress
5. Duplicate studies
6. Short research papers

D. Study selection

As of September, 2021, Initial search resulted into 250 articles reduced to 100 after screening through abstracts and then further excluded 41 articles which did not match the inclusion criteria. 59 articles were read in detail out of which finally 26 articles were selected for final analysis. Although there are numerous studies on the development of CS for engineering graduates, but the authors have chosen only 26 studies as they meet with the inclusion criteria. Since this study intends to assess the effectiveness of pedagogical intervention through empirical evidences, the strength of the evidence supported by the chosen primary studies is one of the most important elements that affects the inferences drawn from and hence the quality of the SLRs (Yang, et al., 2020). During the search process, it was observed that the scholarship on pedagogy for CS contains limited evidenced-based research and this appears to be one of the reasons for a small size of selected studies. Although there were a few relevant seminal research studies such as (Nutman, 1987; Waitz & Barrett, 1997; Jennings & Ferguson,1995; Barren & Watson, 1993), these had to excluded as they were published outside the time duration decided for this review studies. Figure 1 displays the complete article selection process based on the inclusion/exclusion criteria.

Figure 1

Flowchart for Article Selection Process (Adapted from Liberati et al., (2009)

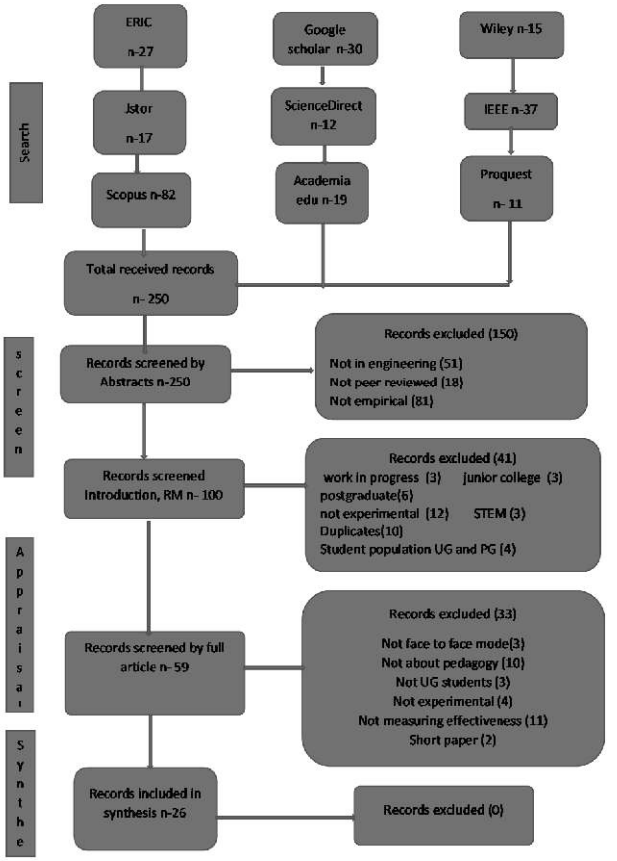

Fig. 1 : Flowchart for article selection process (Adapted from Liberati et al., 2009)

E. Data extraction

After finalizing the research articles, we surveyed the content of the selected studies and gathered detailed information in the following four categories: article metadata, pedagogy, effectiveness measured, and the outcome. Table 2 illustrates the study's coding scheme and lists codes for each category with brief

Table 2 : List of Codes for Analysis of Selected Articles. (Adapted from Luo et al., (2020)

Category	code	Description
Meta data	Title	Title of articles
	Authors	Name of author/s
	year	Year of publication
	location	Country where research conducted
	Type of article	Journal article/conference proceedings
Pedagogy	Instructional pedagogy	Types of teaching-learning approach/methods
	Academic year	Year in which CS courses offered
Effectivenes	Empirical type	Types of empirical study
	sample	Size of population
	data collection	Type of data collection tool
	analysis	Type of data analysis tool
Outcome	Skills	Types of skills developed
	Other learnings	Changes in attitudes and behavior

descriptions. As shown in the table, the metadata provided key information, such as title, author detail, publication year and type of article all of which together made articles' documentation, selection, and classification easy. The other three categories corresponded to the three research questions, respectively: pedagogy reveals the teaching learning methods and examined the trends based on experimental studies; the effectiveness category measures the effectiveness of the approaches on learners' development of CS; the outcome category specifically identifies general as well as specific skills and attributes learned by the students at the end of the academic term.

F. Quality assessment

In order to assess the quality of the selected study, SLR was evaluated using quality assessment criteria adapted from Kitchenham et al. (2009) study which is based on the York University, Centre for Reviews and Dissemination (CDR) Database of Abstracts of Reviews of Effects (DARE) criteria. A review to be included should meet at least four criteria.

QAC1 Were inclusion/exclusion criteria reported?

(refer to Inclusion/exclusion criteria)

QAC2 Was the search adequate?

(refer to figure 1)

QAC3 Were the included studies synthesized?

(refer to figures 2 to 11)

QAC4 Are sufficient details about the individual included studies presented? (refer to appendix)

The above criteria are fulfilled in order to meet the quality standard of the papers chosen.

3. Results

A. Publication trends

Publication trends have shown a fluctuating, yet an overall upward trend in the first two decades. The second decade recorded 80% of the overall research activity, with the research publication increasing significantly after the year 2013 and reaching peak in 2020 before abruptly declining in 2021 (see figure 2). Conversely, the first decade only recorded 20% of the entire research work. The rise in publication, projected by other scholars Gabriele (2005) and Haghighi (2005) seems to be due to the increasing focus on developing generic skills in engineering education, and thus a need for research based innovative methods of teaching CS (Tuononen et al., 2022). On the other hand, the sudden fall could be speculated based on the adverse effects of covid 19 pandemic as well as a lack of quasi/experimental studies in the existing literature. The geographical distribution of publication placed English speaking countries at the top with eleven experimental studies, the trend which was followed by India with six research publications. It was interesting to observe that more than half of the research publication were reported between the year 2017 to 2021 during which India contributed quite significantly with five experimental study leading to the assumption that the paradigm shift in pedagogical practices was quite evident. While it was also observed that other nations like those in the Middle East, Japan, North Africa, Pakistan, Russia, Australia, UK, New Zealand have qualitatively contributed, there are comparatively fewer studies than USA and India. (see figure 3 and table 3). However, the publication trend in the middle east countries seems to be indicative of the increasing awareness of the need for CS for engineering graduates in the second decade of the century with 4 publications.

The publication venue for the selected studies varies, however 90% of the studies are published in Scopus indexed high ranking journals and IEEE is the common venue for conference proceedings. English speaking countries emerge to be the leading contributor and subsequently trend setters in the realm of pedagogical innovation which can be inferred from the publication venues (see table 3). The reason could be attributed to the research published in open access journal which raises their profile globally and increases the likelihood of their work being read and cited in addition to placing more emphasis on research activity and having better resources available (Cretu & Ho,2023). This doesn't appear to be the scenario in developing countries such as Iran, Pakistan, India, Russia, Oman UAE, and Turkey, yet even in these countries quality empirical studies have been published in Scopus-indexed journals.

Table 3 Publication venue

Sr. No	Article (2 to 3 words)	Country	Journal
1	Can game-based……	USA	IEEE Transactions on Professional Communication
2	Developing English communication skills……	North Africa	International Journal of English literature and social sciences
3	Client-based pedagogy…	USA	IEEE Transactions on Professional Communication
4	Case study……	USA	European Journal • Engineering Education
5	Developing technical report writing….	UK	Higher Education Pedagogies
6	Effective methods of teaching….	Japan	IEEE International Conference on Professional Communication
7	Effectiveness of cooperative learning	Turkey	European Journal of Engineering Education
8	English language learning….	USA	Global Journal of Engineering Education
9	Enhancing oral presentation	New Zealand	2009 Annual Conference & Exposition, ASEE
10	Facilitating aural-oral skills….	India	Journal for Engineering Education Transformations
11	Exploring the communication skills….	India	Higher Education Skills and Work-Based Learning
12	Integrating CLIL with CLT….	India	ESP Journal
13	Modified reciprocal teaching….	India	Journal of engineering education transformations
14	Poster presentation ……..	UAE	International Journal of Education and Practice
15	The impact of pedagogical intervention	India	Pertanika Journal of Social Sciences & Humanities
16	Formative assessment	Australia	European Journal of Engineering Education
17	Preparing 1st year engineering …….	USA	126th Annual conference and Exposition, ASEE
18	Teaching 1st year students……	Canada	Proceedings of Canadian Engineering Education Association
19	Teaching oral CS ……	Russia	ASEE, 2016 International Forum
20	The impact of Blended learning….	Iran	International Conference on Teaching and Learning in HE-Procedia – Social and Behavioural Sciences
21	To improve presentation skills……	India	Procedia Computer Science
22	The effects of ESP…….	Saudi Arabia	Journal of Education and Practice
23	Viability of outcome-based education…	Pakistan	Education for Chemical Engineers

Sr. No	Article (2 to 3 words)	Country	Journal
24	Impact of an ESP…….	Oman	International Journal of Higher Education
25	Teaching communication in capstone design…	USA	Journal of Engineering Education
26	Teaching engineering students	USA	International Journal of Engineering Education

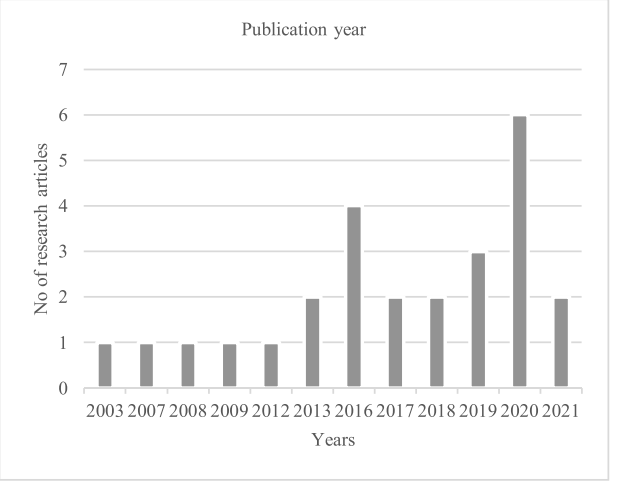

Fig. 2 : Publication of Research Articles During 2001 to 2021

Fig. 3 : Publication of Research Articles in Different Countries

B. Pedagogy in practice

Research on "pedagogy for CS" has proliferated in length and width encompassing innumerable research articles on varied themes. If reporting the pedagogy in practice is concerned, this review study has relied on the findings drawn from experimental studies. Inquiry-based learning, discipline-based learning, and technology-based learning are dominating approaches in engineering classrooms (see figure 4). 19% of total studies have reported the impact of project-based learning (PrBL) and problem-based learning (PBL) methods on the development of CS (Kaddour, 2020; Warnock & Mohammadi-Aragh, 2015; Lamont & Lambert, 2020; Sakran & Prescott, 2013; Grahame & Keyvani, 2019; Paretti, 2018). Although these methods were and are still considered suitable for engineering subjects, are also now used in some countries to prepare students for authentic workplace communication, particularly in USA. This statistic is supported by the evidences reporting that these approaches are used in CS classrooms to make the learners practice and learn English CS (Choudhury, 2019; Heitman,1996; Mills & Treagust, 2003). It was also found that these methods were more suitable for senior students than freshmen, as five out of seven studies showed the effectiveness for the students of third and fourth year (see table 4). However, there are evidences that it was not easy for all the students to adapt to this shift from theoretical to practical way of learning, and therefore some students preferred lectured-based methods over such inquiry-based learning citing the reason of not being able to cover the entire content of the syllabus which affects their grades (Yadav et al., 2010 as cited in Warnock & Mohmmadi-Aragh, 2015). The same number of studies have shown the impact of discipline-based learning approach on students' English CS which was found a preferred method for English language skills in India than in other countries (see table 4). These studies have focused various methods/courses like Blended learning (BL) (Kashefi et al., 2012), work across curriculum (WAC) (Craig, 2016), content and language integrated learning (Venkateshwara & John, 2017), PrBL (Lamont & Lambert, 2020), English for Specific Purpose (ESP) (Albakrawai & Almutairi, 2013; Irudayasamy et al., 2020), Modified Reciprocal Teaching (Kadam & Sawant, 2020), Self reflective teaching (Selwyn & Renaud-Assemat, 2020) etecetera. Technology-based teaching was found very effective to practice and learn oral presentation skills. Various ICT tools were used in the classroom: visual only video teaching strategy (VOVTS) (Santos,

2019), Virtual-i-Presenter (ViP) (Chochraine, 2009), Mobile phone devices (Khan & Thayniath, 2020), Youtube (Nicolic et al., 2017). Other teaching methods such as BL, flipped learning (FL) game-based learning are also gaining acceptance in communication classroom. As far as English language learning is concerned, the methods such as Jigsaw method, Eclectic method, practice-oriented approach were used. Kaushal & Talwar (2021) used oral presentation as a technique to develop CS of first year students. One study by Balzotti & Rawlins (2016) introduced simulation method to provide work-based learning environment in the classroom.

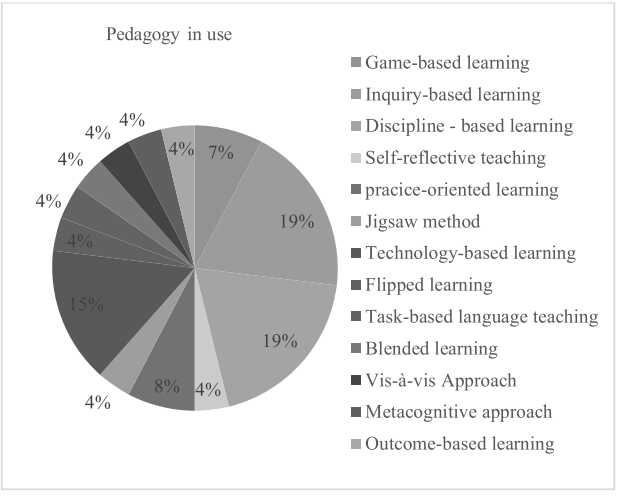

Fig. 4 : Types of methods used

The researchers also surfaced the trend regarding the academic year in which CS courses are offered which tends to be the first year in engineering degree programs as these courses are prep courses or prerequisite courses. This belief was supported by the findings of this review study where 42% of the studies reported that CS courses were taught in the first academic year of degree program, the trend which is widely seen in non-English speaking country. On the contrary, introducing CS courses in senior years was found in American and European countries as can be seen in figure 4, 8% and 12% studies have reported the implementation of the courses in 3rd and 4th year respectively. Moreover, 8% studies have reported in both the semester (see figure 5).

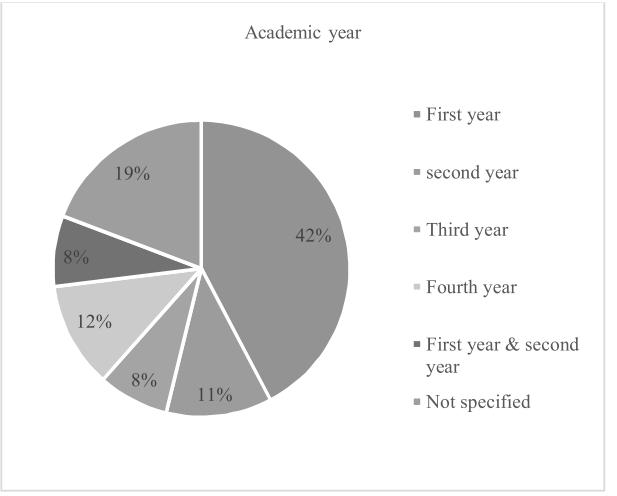

Fig. 5 : Academic year

C. Effectiveness of pedagogical approaches

In order to evaluate the effectiveness of a particular teaching method, we took into account type of empirical study, sample size, tools for data collection and the method of analysis of data. Regarding the type of empirical study used for research, figure 6 shows that 42% of studies used quasi-experimental design followed by mixed-method design which was used by 39% studies. The other studies adopted either quantitative methods or qualitative methods to assess the performance as well as the perception of students. We further examined the study by paying attention to the sample size used by the researchers that varies to a great extent (see figure 7). Studies conducted by Borden & Clark, (2016), Selwyn & Renaud-Assemat (2020) and Kaushal & Talwar (2021) were more reliable in terms of generalizability than other studies as they used 300, 280 and 240 population size respectively.

Regarding data collection and data analysis, we identified six sources of empirical data and two major types of analysis tools. Questionnaires were the most

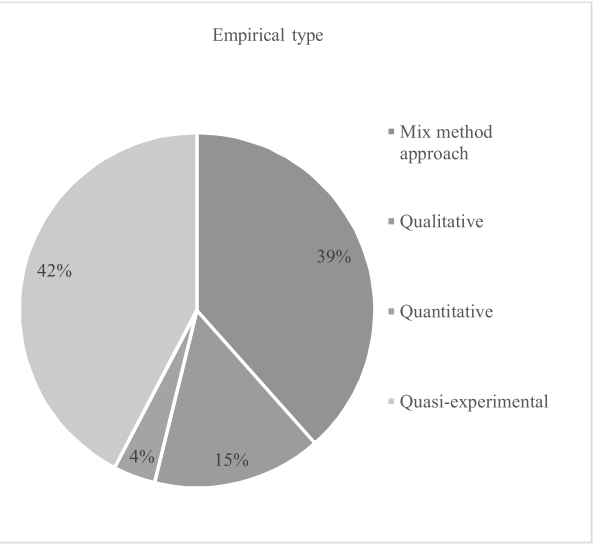

Fig. 6 : Type of empirical study

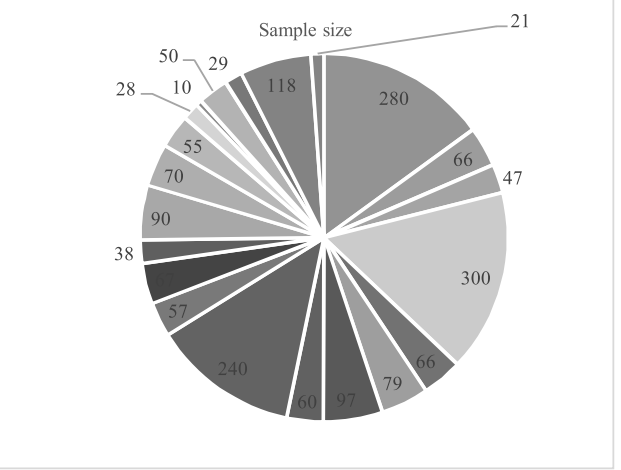

Fig. 7 : Population size

used method for collecting data from learners with 37% followed by 18% of studies using test score for collecting quantitative data (see figure 8). In addition to these, field notes, feedback and semi-structure interviews were also used to assess learning outcomes. Around 21% studies used interviews as a data collection tool to seek students' perception on the effectiveness of pedagogy as well as their leaning outcome. Field notes consisted of teacher observation, teacher diary, video recordings of presentation, teaching learning activity details etc., were used to analyze students learning behavior.

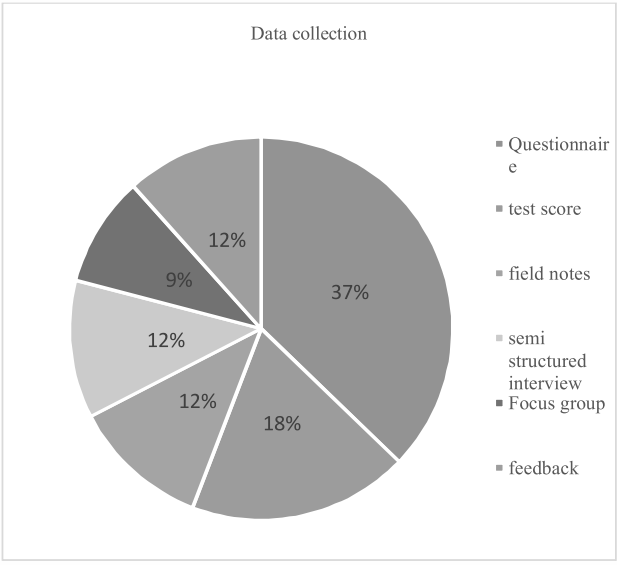

Fig. 8 : Tools of data collection

Further we focused on thematic analysis tool to analyse qualitative data and statistical tools to analyse quantitative data. It was observed that 42% of the studies did not explicitly state the tools used to analyse the data. 46% of studies used statistical tools such as t

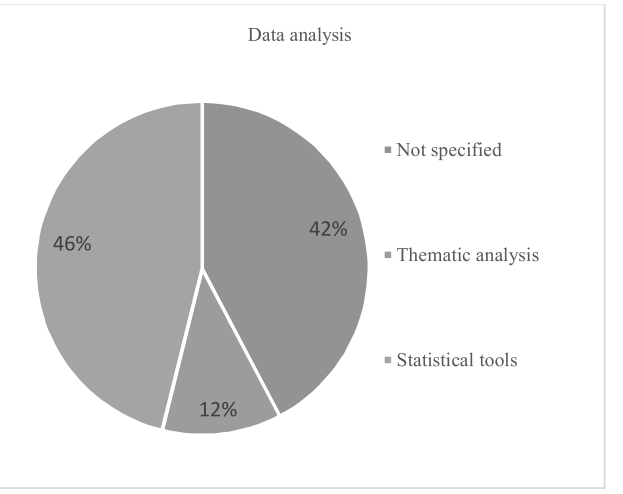

Fig. 9 : Tools for data analysis

test, statistical discovery software, Microsoft excel, Wilcoxon signed-rank test, and IBM SPSS software and 12% studies used thematic analysis where the interview transcripts were coded and analysed, feedback and comments were categorized (see figure 9). Although the overall impact of the instructional pedagogy was positive on the learning outcome of the students, some detractors of these approaches were also reported in some studies.

D. Skills developed

The results revealed that majority of the experimental research studies have reported the development of CS such as speaking and listening skills, reading comprehension, oral or technical oral presentation (discussing and verbalizing disciplinary content), technical writing, writing a report, proposal, grammar and vocabulary, graphical communication, English pronunciation, etcetera (see table 4). Figure 10 shows that 32% of research studies have reported

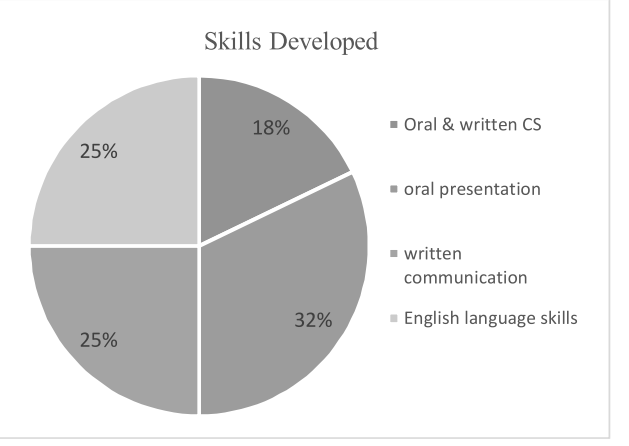

Fig. 10 : Skills developed

the development of oral presentation skills and 18% oral and written communication whereas 25% written communication skills. Apart from CS, other professional skills and attributes were also developed such as problem solving, leadership skills, team work, critical thinking, cognitive skills, self-directed leaning etcetera.

Figure 11 gives a distribution of generic skills and attributes reported in all these studies. However, the learning outcome should not be perceived in such a discrete category as these skills and attributes are the learning outcome of almost all the studies. Still, PBL and PrBL have largely contributed to self-directed learning (SDL) and problem-solving skills whereas for teaching oral presentation, ICT-based methods are preferred. Improvement of English language proficiency (LSRW, grammar, vocabulary) is the result of discipline-based learning along with other methods such as outcome-based learning (Yasmin & Yasmeen, 2021), Jigsaw II (Gomleks'iz, 2007), BL (Kashefi et al., 2012), etcetera. The learning is also reflected in the attitudinal and behavioral changes of the learners. There is more awareness of the importance of CS at the workplace. In addition to this, the adoption of these innovative methods has contributed in the confidence building and increased learners' motivation and interest towards developing CS.

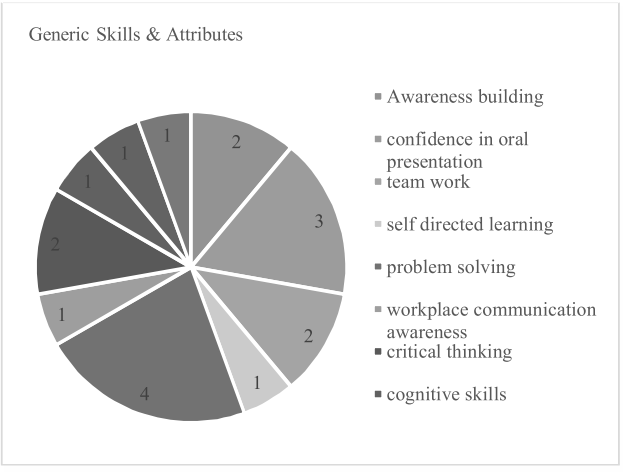

Fig. 11 : Other skills and attributes developed

It was also found that advanced level of English proficiency or CS was developed when humanities courses are offered in senior years. Two studies have conducted experiments on senior students (not specified the academic year or semester) which have reported positive outcome in terms of authentic workplace communication, SDL and transferable CS. Three studies have focused on the development of English pronunciation for presentation, using self and peer assessment to develop presentation skills and enhancement of CS through PBL. Two, third year courses have developed authentic communication and oral presentation using ViP. The methods and techniques used in senior years demand high cognitive skills as well as basic linguistic command.

4. Discussion

RQ 1. What is the trend in research in pedagogy for CS in engineering education in 21st century?

The overall publication trends reveal that the scarcity of experimental research is quite plainly evident in the existing pedagogy literature, however the rising movement in the second decade is indicative of importance and awareness of research for best teaching practices in developing countries. The rise in publication, projected by other scholars Gabriele (2005) and Haghighi (2005), seems to be due to the increasing focus on developing generic skills in engineering education in addition to acquiring domain-specific knowledge and skills which is frequently cited as the primary goal of higher education, as these skills will be useful both during the transition to the workforce and afterwards in one's career (Shavelson et al, 2019; Tunonen et al, 2019). Subsequently, the perceived need to adopt research-based pedagogy in CS classroom to be effective which could be supported by the study by Froyd & Lohman (2014) who have attested the influence of research on innovative pedagogy in engineering education, though not specifically on the humanities course. On the contrary, minimal research work reported in some countries or no publication is assumed to be due to the prevailing ignorance about the need and awareness of generic skills, particularly CS among engineering student community and also because of less awareness of the influence of research-based teaching practices to facilitate skill development which is reflected in the persistent dissatisfaction over the CS competency level of graduates. Therefore, the limited existing research did justify the need for experimental research which appears to have ushered in the realm of pedagogical innovations for classroom teaching. The impetus for research-based teaching could be attributed to the importance ascribed to generic skills by various accreditation bodies such as Accreditation Board of Engineering and Technology (2014),

Canadian Engineering Accreditation Board (2014), Accreditation Board for Engineering Education of Korea (2013), and Engineering Accreditation Council, Malaysia which brought the generic skills to the forefront as it was also the need of the industry. The sudden fall in publication after the year 2020 could be attributed to the adverse effects of covid 19 pandemic which deprived the research scholars from the opportunities to carry out field work to collect data. According to Bania & Dubey (n.d.) the pandemic has had a considerable impact on the fundamental techniques for doing qualitative research, including in-depth personal interviews, focus groups, and observation. Moreover, ever since the advent of Covid 19, there had also been a decrease in the amount of field research conducted in developing nations and 4% decrease in the number of publications produced by researchers in these nations (Richardson, 2020). Apart from this, in the present context, the other reason for a small quantity of papers could be that papers written before September 2021 may be in the process of review and not published yet. From the perspectives of geographical distribution as well as publication venue (refer to table 2 and fig. 3) American and European universities give the impression of being the leading contributors in prescribing innovative pedagogies which points to the fact that developed countries are more aware of the need of CS for engineers and subsequently of effective pedagogy, along with the access to the best resource for research. This inference can be supported by seminal research carried out at the premier academic institutions such as MIT, Leeds Polytechnic, Queen's university, Monash university, Temple university, etcetera and was then published in 20th century in reputed journals (Jennings & Ferguson, 1995; Keane & Gibson, 1999; Yeo, 2001; Nutman, 1987; Baren & Watson, 1993; Johannes & Kasteren, 1996; Freedman & Artemeva, 1998; Waitz & Barrett, 1997). Concurrently, the upsurge in the publication, particularly in Middle east countries and Asian countries, specifically India have shown increasing awareness of research-based innovative pedagogy. This change is due to the importance of employability due to combined effects of globalization, changing work patterns and technological advancements (Markes, 2006), which encourages the HEIs to integrate generic skills into the curriculum and adopt pragmatic methods of developing them (Meier et al., 2000).

RQ 2. Which approaches/methods are used in engineering classroom to teach CS?

21st century bears witness to the paradigm shift in pedagogical practices of teaching English/communication skills in engineering education which can be attributed to various driving as well as compelling forces such as the influences of research in education, leaning and social behavior (Froyed et al., 2012), the changing demand of the workplace (Kulhanek et al., 2019; Dannels, 2002), and most importantly to minimize the gap between what is taught in the university and what is required at the workplace (Nair et al., 2009; Zaharim et al., 2010; Blom & Saeki, 2011). Inquiry-based teaching-learning approaches have found place in CS classrooms as they best provide the opportunity not only to practice CS but also develop other professional skills which are generally expected by employers. Methods such as PBL, PrBL, challenge-based learning etcetera, are used with the rationale of motivating the learners to work in collaboration to solve a problem or accomplish a project providing them with the opportunity to practice generic skills in an authentic situation and thus, making communication more real and purposeful. Heitmann's (1996) study supports the wide use of PrBL in which he cited several examples of universities where this approach is used. Aalborg university, Monash University and Central Queensland University in Australia have been using PrBL method in their undergraduate engineering programs to develop non-technical skills. However, such methods are more suitable to learners of English-speaking countries assuming that the use of such methods demand learners to be proficient users of English which seems to be lacking in non-English speaking countries. Nevertheless, this barrier can be overcome by forming group-based tasks where students who are proficient in language as well as good in subject knowledge can become student-trainers to assist others. This will not only lead the group to the successful completion of project but also develop other generic skills such as team work, interpersonal skills, collaborative skills etc. (Nelavai & Ramesh, 2019). The adoption of discipline-based teaching stems from the unpleasant experience of failure using conventional methods (Waitz & Barret, 1997; Yeo, 2001; Torres-Barreto et al., 2020). Having realized that teaching communication cannot be divorced from the disciplinary subjects, content-based methods such as ESP, WAC, FL, and modified reciprocal teaching are used to develop English proficiency. A few seminal research papers published in the last decade of 20th century in Europe and America echoed the use of

content-based methods to develop CS (Jennings & Ferguson, 1995; Johannes & Kasteren, 1996; Nutman, 1987). Based on the findings, discipline-based learning approach appears to be more suitable to second language learners than native speakers because it integrates language with disciplinary content and thus makes language learning purposeful. Technology-based approach has been proved very interesting in teaching oral presentation skill as the methods such as using YouTube for assessment, VOTS, ViP, language learning apps, etcetera provide an opportunity to students to use self and peer evaluation of their presentation and enhance pre-requisite skills which have been effective in increasing students' confidence. Other methods such as game-based learning, blended learning, self-reflective teaching, Jigsaw method, outcome-based learning, Eclectic approach etcetera are also used in different countries. On the flipside, it is widely felt that the use of lecture-based method may not help students develop communication skill, leadership skills, problem solving skills etcetera, but regrettably this approach is still predominantly being used in many countries (Al Riyami, 2021; Felder et al., 2000; Mills & Treagust, 2003; (Roehl et al., 2013: Choudhury, 2019) which could be due to lack of research in the domain (see figure 2 & 3). Although there are plenty of research articles published on pedagogy for CS, there is a scarcity of experimental work which makes a teacher less resourceful in regard with methodology aspects. This findings can be supported by the current research on perception of stakeholders, particularly employers who still complains about the poor CS amomg engineers. This projects the realistic picture of the pedagogical practice in use in some region of the world, especially developing countries.

RQ 3. What is the impact of instructional pedagogy on the development of CS?

In this study, a few articles did not include statistical data or other observations that would have enabled meta-analysis of the experimental research studies. Additionally, such comparison was difficult due to data such as field notes, exam scores, feedback, and comments. However, the results indicated that the teaching-learning methods were more effective than traditional method of teaching. The PrBL and PBL methods had overall positive impact on engineering student' CS as well as professional skills. Balzotti & Rawlins (2016) used the blending of simulation method and client projects to create a workplace situation into which writing assignment was situated. Engineering multidisciplinary projects (EMDPs) have proven to be effective in providing opportunity to engage in real communication with real audience (Sakran & Prescott, 2013). Such projects made the learners aware of the authentic workplace communication and increased their motivation to participate in the skill development courses as they found the real purpose of learning and using CS. Grahame & Keyvani (2019), showed the effectiveness of PBL in increasing the confidence of students' written and oral communication. However, the limitations were reported that the transition from traditional method of learning to this new approach was not easy (Kaddour, 2020; Balzotti & Rawlins, 2016), some students preferred lecture-based method instead of PrBL or PBL as these methods would focus on a specific problem and would not be able to cover the content which would ultimately result in low grades. In order to bridge this gap, students should be exposed to the experiential learning approach from the first year (Warnock & Mohammadi-Aragh, 2015) initially with guided learning or scaffolding techniques gradually allowing them to work independently. At the same time, this kind of approach also demands change in the curriculum which should be more pragmatic in nature than theoretical so that it can prepare students for application-oriented learning rather than exam-oriented learning. However, the ESL students found it difficult to adopt such inquiry-based learning due to the lack of English language proficiency, required to carry out a project and this could be the reason for limited research on inquiry-based learning in non-English speaking countries. It is also to be noted that this approach is offered in higher semester as four out of six experiments were conducted with senior students either in third or fourth year, based on which it can be assumed that this method demands some level of cognitive maturity along with some English language proficiency to cope with the projects or problems assigned to them. This assumption is supported by an example of Monash University in Australia which introduced PrBL and PBL during third and fourth academic year considering them suitable for these methods to be used. (Mills & Treagust, 2003). Insufficient language proficiency to carry out learning task is a commonly encountered problem among students of Asian countries which can be reduced to a manageable level by offering foundation courses before the start of the academic year. A diagnostic test could be conducted to identify the specific language problems and the varying needs can be catered (Nelavai & Ramesh,

2019). In order to have moderately homogenous class in terms of language proficiency in particular, the other strategy is to set a bench mark for entry-level proficiency to enroll in the engineering UG courses through some standardized testing system such as IELTS or Common European Framework of Reference for languages (CEFR) (Mohapatra & Satpathy, 2014). Technology-based teaching approach has been proved effective to teach CS in the engineering classroom in terms of creating conducive and productive learning environment, making the learning process interesting and promoting flexibility. It was interesting to note that ICT tools were very effective to teach oral presentation. ViP was very effective in preparing students for live oral presentation which provided the students opportunity to practice and review their own presentation (Chochraine, 2009). The use of VOVTS was very effective as this strategy matched with the learning style of the engineering students who prefer Internet-based online learning platform. The students found it most suitable for their English language training for employment after graduation (Santos, 2019). Using YouTube, mobile app, open online resources, video recorder were some of the tools used to develop oral proficiency, pronunciation, aural-oral skills etc.

The effectiveness of discipline-based learning was seen in both CS as well as professional skills. The results of qualitative and quantitative data showed overall positive impact on students' learning. i.e., affective factor (sense of achievement), cooperative learning, enhanced confidence, and English proficiency, particularly reading comprehension (Kadam & Sawant, 2020), self-efficacy and oral presentation (Craig, 2016), facilitated learning and achieve course learning objectives (CLOs) and program learning objectives (PLOs) (Yasmin & Yasmeen, 2021). ESP courses helped the students increase motivation, interest and enthusiasm which is due to the integration of CS into the engineering core discipline or teaching content through language (Albakrawai & Almutairi, 2013; Irudayasamy et al., 2020), communication for mathematical ideas (Kashefi et al., 2012). T-test was used by Gömleksi˙z (2007) to measure the impact of Jigsaw II method on students' vocabulary and active-passive voice. A statistically significant difference revealed the effectiveness of classroom environment which used Jigsaw method and showed improvement in the experimental group. In another study, Wilcoxon Signed Ranks test for CS was used to see the impact of blended learning approach which revealed that students have improved their CS (Kashefi et al., 2012). Bodnar & Clark (2017) used Quade's test to test the impact of games on students' written and oral communication in the form of GPA. The results showed the trend of improved CS but no statistically significant result was found which they think was due to small sample size. Students' comments showed that there was no relevance to their achievement area, they wondered how games contributed to their learning and therefore it was quite unclear whether the change was due to the inclusion of games.

RQ 4. What is the learning outcome of these approaches?

Based on the findings drawn from each empirical study, it is revealed that the learning outcome at the end of the course or a specific experimental study is manifold. The outcome was seen in the development of various CS, professional skills, and acquisition of graduate attributes as well as positive change in learners' attitudes towards humanities courses. This is due to the paradigm shift from CS as a stand-alone course to integrating it with engineering curriculum which has been perceived very motivating and rewarding by the students (Bowering, 2013; Du, 2021). Therefore, it can be inferred that CS cannot be/ought not be taught in isolation because skills like problem solving, decision making, critical thinking, team work, leadership skills etcetera are inter-linked with CS, and hence these skills cannot be separated from teaching and learning CS. This inference is supported by other studies which showed the development of other professional skills along with CS (Johannes & Kasteran, 1996; Mills & Treagust, 2003; Owens & Hite, 2020; Warnock & Mohmadi-Aragh, 2015). As far as CS is concerned, it has been observed that significant development of productive skills (oral and written communication) has been prominent in the research findings. The emphasis could be due to the need for engineers to spend more time on oral and written communication at workplace (Dannels, 2002) and this was also echoed in a survey where engineering graduates highlighted the requirement of oral presentation at workplace (Shinge & Kotabagi, 2019). Considering the development of oral presentation skills, the students' survey demonstrated that game-based approach increased students' perceived communication skills, along with their confidence level. They also mentioned that game-based activities draw their attention to the target audience for their written or oral presentation which generally doesn't seem to be part of learning during

CS courses (Bodner & Clark, 2016). Similar kind of response was elicited from students' comments where they asserted developing oral presentation skills using "Vip" an ICT tool (Chocrane, 2009). Slightly dissimilar results were recorded by Nikolic and his teammates who applied formative assessment approach to develop oral presentation skills. The students did admit the benefits of peer and self-assessment techniques; however, it did not significantly result in the improvement of their skills as formative assessment did not reflect in the final grades. It can be speculated that unless students' involvement in the tasks and activities doesn't bring them a reward in terms of marks, they are less likely to adopt a new approach. On the other hand, use of reflective methods enabled the students to realize the importance of writing skills as well as help them to develop skills of self-reflection for writing skills, but some students commented that they found it difficult to comment on their work. Based on the findings, it can be suggested that such methods are difficult to use in first year classes as the students may be too young to possess or learn such high order skills.

Apart from improving CS, other professional skills and attributes were developed too, such as problem solving and decision making, team work, critical thinking, motivation, learner autonomy. This was reflected in the students' feedback. "Very challenging but helpful. I would consider one of the most useful classes I have taken" and "Though I often hated him for the complexity of the problems, I learned a great wealth of knowledge in this class. I'm sure my critical thinking skills were improved" (Warnock & Mohammadi-Aragh, 2015, pp 149). A student's reaction to practicing authentic communication through client-based pedagogy was reported: "I think it's interesting that the teacher plays the role of a real-world supervisor. It's very different from any other course I've taken, and I like it because it strengthens the idea that we're creating work for a real client. I assume that this role is played to give us an idea of how a real-world technical communication project is run" (Balzotti & Rawlins, 2016, pp 150).

As far as English language proficiency is concerned, students were found to have developed language skills but a common learning outcome was perceived in the affective domain of the learners reflecting in positive attitude towards English, more awareness, increased motivation and interest to learn and gained confidence in using language skills. Having exposed to these approaches, the learners have got the opportunity to develop many professional skills and attributes such as self-directed learning, self-efficacy, learner autonomy, awareness raising, etcetera.

A. Impact of the study

Since this SLR provides clear and comprehensive overview of the pedagogy, it can increase the awareness of the various methods used to develop English CS across nations and further explore them to make teaching-learning of humanities course more purposeful and interesting for students. One of the findings of this SLR draws our attention to the need for accelerating the experimental research work which can make the teaching-learning of humanities courses better. Therefore, it should motivate the researchers as well as practicing teachers to carry out experimental studies and contribute in the realm of evidence-based teaching-learning practices. The experimental or empirical nature of each study has an impact on promoting evidence-based or research-based teaching approaches to teach non-technical skills in engineering institutions. Lastly, future primary data-based research that confirm the results of secondary data will build on the findings of the current study.

B. Limitations

This study's primary limitation is focusing only on papers that met inclusion criteria during the search process. As a result, many conceptual papers and perception studies that describe pedagogical approaches in particular contexts could be excluded and thus, failed to give exact picture of pedagogical practices used in the academic institutions.

In our summary of selected papers, we put a category called "NS" because a few papers had limited information about metadata and research methodology used. As a result, analysis of pedagogy's effectiveness may have been affected. These papers, however, were kept since they contain information relevant to other research questions.

Finally, the conclusion drawn about the effectiveness of each approach on learning CS may not be consistent in terms of the measurement tools used as some studies did not mention the standard data analysis tools used. In order to resolve this issue, further research could be more precise about the inclusion exclusion criteria.

C. Implications

The findings of this research studies can be used by researchers as well as the teachers who are in the field of engineering education. Since this study reveals that there is a paucity of experimental study on the impact of a pedagogical approaches on CS, specifically in developing countries, an empirical study can be carried out at a regional level to find out different teaching methods used to develop CS and the effects of these methods on the students' learning outcome. Researchers can also conduct either a longitudinal study or quasi-experimental research to ascertain the effectiveness of a particular teaching-learning approach on students' learning in a specific engineering branch or engineering program in general. Based on the findings of this study, further SLR can also be carried out to measure the effectiveness of a particular teaching method being widely used in a country which can throw light on contextual variation in implementing the methods that can be useful for a teacher.

Teachers can use the findings to either adopt a new approach or adapt the existing one according to their context and use it to help engineering students become competent users of language. The results may help the teachers to widen their perception on the whole skill development gamut and may encourage them to incorporate other professional skills too and make the learning more integrative. This study can motivate the teachers to try out something new in their small-scale teaching projects and assess the outcome which can further be expanded to a larger scale. It could also be used to make teachers aware of the new demands created by these innovative approaches in terms of updating their knowledge and skills, particularly in the field of ICT and being more resourceful.

D. Conclusion

This review study analyses 26 empirical research studies on teaching CS in engineering institutions across globe. The publication trends showed that American and European countries have outnumbered other countries in publishing experimental research and further appear to be trend setters in introducing new pedagogies which have been effective in developing CS in engineering institutions, nevertheless other countries have also realized the importance of tried and tested methods and therefore contributed in the experimental research but they are in their infancy stage. However, a number of publications documented in different regions, particularly Asian countries draws our attention to the lack of experimental research in the domain which could be one of the factors for a lack of effective pedagogy consequently resulting in poor CS. As far as the teaching-learning practices are concerned, the results revealed that 21st century witnessed to the paradigm shift in the instructional pedagogy in engineering education, reflected in adopting pragmatic instructional methods such as content-based learning, PrBL, PBL, BL, FL, TBLT, etcetera that provide authentic work-based learning opportunities to practice and develop CS as well as other professional skills. The novel instructional approaches such as inquiry-based learning, discipline-based approach, technology-based learning have found their places in engineering classroom and have had positive impact on students' learning outcome due to their inherent nature of dealing with real life issues, collaboration and relevance to students' discipline which finally makes them employability oriented. However, these methods are more popular in English speaking countries than in non-English speaking countries because of the pre-requisite skills required (linguistic and communicative competence) to carry out the learning tasks which are assumed to be lacking in second or foreign language learners. The outcome of these approaches is reflected in the development of CS, professional skills and attributes and also brought about a positive change in students' attitude and behavior towards acquiring non-technical skills in engineering institutions. On the contrary, it was also found that these new methods posed challenges among the students due to their English language barriers, lack of higher order generic skills, and their belief and attitude towards learning CS rooted in the traditional way of education. The measured effectiveness of these methods on the development of CS seems to have some amount of reliability threats due to the inconsistent, varied data collection tools as well as the lack of scientific data analytical tools. The lack of evidence-based research on the pedagogical practices leads to the assumption that still conventional lecture-based method is widely used to "teach skills" – one of the ever-found responsible factors for lack of CS that needs serious attention from the academia. This study has an implication for both a teacher and a researcher who wish to conduct an experimental study in the classroom to measure the impact of a particular teaching method on learning outcome which can help them identify the affecting as well as contributory factors to the development of CS.

This study highly recommends the need for evidence-based teaching learning practices in the engineering classroom to prepare communicatively competent and skilled engineers.

References

[1] Albakrawai, H. D. M., & Almutairi, F.M. (2013). The effect of ESP program on the engineering students' proficiency at the university of Tabuk. Journal of Education and Practice, 4(3), 117-124.

[2] Al Riyami, T. K. (2021). Omani graduates' English communication skills: Employers' perspectives. Learning and Teaching in Higher Education: Gulf Perspectives, 17(2), 136–149. https://doi.org/10.1108/lthe-01-2021-0007

[3] Aviv, R. (2007). Don't be shy. Retrieved 30 January 2008 from http://www.nytimes.com/2007/11/04/education/edlife/reticence.html?fta=y&pagewanted=all

[4] Balzotti, J., & Rawlins, J. D. (2016). Client-based pedagogy meets workplace simulation: Developing social processes in the Arisoph case study. IEEE Transactions on Professional Communication, 59(2), 140–152. https://doi.org/10.1109/tpc.2016.2561082

[5] Bania, J., & Dubey, R. (n.d.). The Covid-19 Pandemic and Social Science (Qualitative) Research: An Epistemological Analysis. In https://www.guninetwork.org/report/covid-19-pandemic-and-social-science-qualitative-research-epistemological-analysis.

[6] Baren, M. R., & Watson, J. (1993). Developing communications skills in engineering classes. Proceedings professional communication conference the new face of technical communication: People, processes, products, October 1993, 432-437. https://doi.org/10.1109/IPCC.1993.593906

[7] Baumeister, R. F., & Leary, M. R. (1997). Writing narrative literature reviews. Review of General Psychology, 1(3), 311–320. https://doi.org/10.1037/1089-2680.1.3.311

[8] Blom, A., & Saeki, H. (2011, April). Employability and Skill Set of Newly Graduated Engineers in India (Working Paper Series No. 5640). Policy Research Working Papers. https://doi.org/10.1596/1813-9450-5640.

[9] Bodnar, C. A., & Clark, R. M. (2017). Can game-based learning enhance engineering communication skills? IEEE Transactions on Professional Communication, 60(1), 24–41. https://doi.org/10.1109/tpc.2016.2632838

[10] Borrego, M., Foster, M. J., & Froyd, J. E. (2014). Systematic literature reviews in engineering education and other developing interdisciplinary fields. Journal of Engineering Education, 103(1), 45–76. https://doi.org/10.1002/jee.20038

[11] Bowering, R. (2013, June). Invited paper - Preparing the global engineer: How learning to teach in a Service-Learning project develops effective communication skills in engineering students. ASEE International Forum, Atlanta, Georgia, USA. https://doi.org/10.18260/1-2-17251

[12] Cavalcanti, A. P., Barbosa, A., Carvalho, R., Freitas, F., Tsai, Y. S., Gašević, D., & Mello, R. F. (2021). Automatic feedback in online learning environments: A systematic literature review. Computers and Education: Artificial Intelligence, 2(2021). https://doi.org/10.1016/j.caeai.2021.100027.

[13] Choi, E. M. (2013). Applying inverted classroom to software engineering education. International Journal of E-Education, e-Business, e-Management and e-Learning, 3(2), 121-125. https://doi.org/10.7763/ijeeee.2013.v3.205

[14] Choudhury, P. K. (2019). Student assessment of quality of engineering education in India: Evidence from a field survey. Quality Assurance in Education, 27(1), 103–126. https://doi.org/10.1108/qae-02-2015-0004

[15] Clement, A., & Murugavel, T. (2015). English for employability: A case study of the English language training need analysis for engineering students in India. English Language Teaching, 8(2), 116-125. https://doi.org/10.5539/elt.v8n2p116

[16] Cochrane, T. (2009, June), Enhancing the oral presentation skills of engineering students: Technology to the rescue with the Virtual I Presenter (Vip). 2009 Annual Conference & Exposition, Austin, Texas, USA. https://doi.org/10.18260/1-2—4913

[17] Craig, J. (June 25, 2016). Teaching Oral Communication at a Russian university: Helping English language learners present their engineering design [Paper presentation]. ASEE International forum, New orleans, Louisiana.

[18] Cretu, D.M.; Ho, Y.-S. The Impact of COVID-19 on Educational Research: A Bibliometric Analysis. Sustainability 2023, 15, 5219. https://doi.org/10.3390/su15065219.

[19] Dannels, D. P., Anson, C. M., Bullard, L., & Peretti, S. (2003). Challenges in learning communication skills in Chemical engineering. Communication Education, 52(1), 50–56. https://doi.org/10.1080/03634520302454

[20] Donnell, J. A., Aller, B. M., Alley, M., & Kedrowicz, A. A. (2011). Why industry says that engineering graduates have poor communication skills: What the literature says. Proceedings of ASEE Annual Conference & Exposition. https://doi.org/10.18260/1-2--18809

[21] Dos Santos, L. M. (2020). The discussion of communicative language teaching approach in language classrooms. Journal of Education and E-Learning Research, 7(2), 104–109. https://doi.org/10.20448/journal.509.2020.72.104.109

[22] Du, J. (2021). English applied ability teaching reform of mechanical design and manufacturing in ESP teaching mode. Journal of Physics: Conference Series, 1820(1). https://doi.org/10.1088/1742-6596/1820/1/012017

[23] Felder, R. M., Stice, J. E., & Rugarcia, A. (2000). The future of engineering education vi: Making reform happen. Chemical Engineering Education, 34(3), 208–215.

[24] Ford, J. D., & Riley, L. A. (2003). Integrating communication and engineering education: A look at curricula, courses, and support systems. Journal of Engineering Education, 92(4), 325–328. https://doi.org/10.1002/j.2168-9830.2003.tb00776.x

[25] Freedman, A., & Artemeva, N. (1998). Learning to teach writing to engineers. Canadian Journal for Studies in Discourse and Writing/Redactology, 14(1). https://doi.org/10.31468/cjsdwr.420

[26] Froyd, J. E., & Lohmann, J. R. (2014). Chronological and Ontological Development of Engineering Education as a Field of Scientific Inquiry. In Johri, A., & Olds B. M. (Eds.), Cambridge Handbook of Engineering Education Research, pp. 3–26. Cambridge University Press. https://doi.org/10.1017/cbo9781139013451.003.

[27] Froyd, J. E., Wankat, P. C., & Smith, K. A. (2012). Five major shifts in 100 years of engineering education. Proceedings of the IEEE, 100(special centennial issue), 1344–1360. https://doi.org/10.1109/jproc.2012.2190167

[28] Gabriele, G. A. (2005, July). Advancing engineering education in a flattened world. Journal of Engineering Education, 94(3), 285–286. https://doi.org/10.1002/j.2168-9830.2005.tb00852.x

[29] Gömleksi˙z, M. N. (2007, October). Effectiveness of cooperative learning (jigsaw II) method in teaching English as a foreign language to engineering students (Case of Firat University, Turkey). European Journal of Engineering Education, 32(5), 613–625. https://doi.org/10.1080/03043790701433343.

[30] Gough, D., Thomas, J., & Oliver, S. (2012). Clarifying differences between review designs and methods. Systematic Reviews, 1(1). https://doi.org/10.1186/2046-4053-1-28.

[31] Grahame, K.S., & Keyvani, L. (2018, July). Preparing first-year engineering students for a career where communication skills matter. [Paper presentation). 2018 FYEE Conference, Glassboro, New Jersey, USA. https://peer.asee.org/31416

[32] Gray, F. E. (2010). Specific Oral Communication Skills Desired in New Accountancy Graduates. Business and Professional Communication Quarterly, 73(1), 40–67. https://doi.org/10.1177/1080569909356350.

[33] Haghighi, K. (2005, October). Quiet no longer: Birth of a new discipline. Journal of Engineering Education, 94(4), 351–353. https://doi.org/10.1002/j.2168-9830.2005.tb00862.x

[34] Heitmann, G. (1996). Project-oriented study and project-organized curricula: A brief review of intentions and solutions. European Journal of Engineering Education, 21(2), 121–131. https://doi.org/10.1080/03043799608923395

[35] Irudayasamy, J., Souidi, N. M., & Hankins, C. (2020) Impact of an ESP course on English language proficiency of undergraduate engineering students: A case study at Dhofar University. International Journal of Higher Education, 9(2), 309–320. https://doi.org/10.5430/ijhe.v9n2p309

[36] Jabarullah, N. H., & Hussain, H. I. (2019). The effectiveness of problem-based learning in technical and vocational education in Malaysia. Journal of Education and Training, 61(5), 552–567. https://doi.org/10.1108/et-06-2018-0129.

[37] Jennings, A., & Ferguson, J. (1995). Focusing on communication skills in engineering education. Studies in Higher Education, 20(3), 305–314. https://doi.org/10.1080/03075079512331381575

[38] Johannes, M. N., & Kasteren, V. (1996). Interdisciplinary teaching within engineering education. European Journal of Engineering Education, 21(4), 387–392. https://doi.org/10.1080/03043799608923424

[39] Kadam, D. M., & Sawant, S. Y. (2020). Modified Reciprocal Teaching: Cooperative Learning Technique for Enhancing Communication Skills of First Year Engineering Students. Journal of Engineering Education Transform, 33(Special issue).

[40] Kaddour, K. B. (2020). Developing English communication skills through project-based learning: The case of ENSAM engineering students. International Journal of English Literature and Social Sciences, 5(3), 649–656. https://doi.org/10.22161/ijels.53.12

[41] Kakepoto, I., Habil, H., Omar, N. a. M., Boon, Y., & Iqbal, S. M. Z. (2012). The Picture of Modern Workplace Environment and Oral Communication Skills of Engineering Students of Pakistan. International Journal of Applied Linguistics and English Literature, 1(5), 42–48. https://doi.org/10.7575/ijalel.v.1n.5p.42

[42] Kashefi, H., Ismail, Z., & Yusof, Y. M. (2012). The impact of blended learning on communication skills and teamwork of engineering students in Multivariable Calculus. Procedia - Social and Behavioural Sciences, 56, 341–347. https://doi.org/10.1016/j.sbspro.2012.09.662]

[43] Kassim, H., & Ali, F. (2010). English communicative events and skills needed at the workplace: Feedback from the industry. English for Specific Purposes, 29(3), 168-182. https://doi.org/10.1016/j.esp.2009.10.002.

[44] Kaushal, U. & Talwar T. (2021). Exploring the communication skills of Indian undergraduates: A partial ethnographic study. Higher Education, Skills and Work-based Learning, 12(2). https://doi.org/10.1108/HESWBL-09-2020-0217.

[45] Keane, A. & Gibson, I. S. (1999). Communication trends in engineering firms: Implications for undergraduate engineering courses. International Journal of Engineering Education, 15(2), 115–121.

[46] Khan, S.M. & Thayniath, S. (2020). Facilitating aural-oral skills of engineering students through the flipped classroom. TEST Engineering & Management, 82, 154–167.

[47] Kitchenham, B. (2004). Procedures for Performing Systematic Reviews. Keele University Technical Report TR/SE-0401. http://artemisa.unicauca.edu.co/~ecaldon/docs/spi/kitchenham_2004.pdf

[48] Kulhanek, A., Butler, B., & Bodnar, C. A. (2019, June 30). Motivating first- year engineering students through gamified homework. Educational Action Research, 29(5), 681–706. https://doi.org/10.1080/09650792.2019.1635511

[49] Labun, C. (2011). Teaching engineering communication to first year engineering students. Proceedings of the Canadian Engineering Education Association (CEEA). https://doi.org/10.24908/pceea.v0i0.3771

[50] Lamont, G., & Lambert, S. (2020). Teaching first-year students to communicate problem analysis and investigation with an engineering-specific writing model. Proceedings of the Canadian Engineering Education Association (CEEA). https://doi.org/10.24908/pceea.vi0.14165

[51] Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. British Medical Journal, 339. https://doi.org/10.1136/bmj.b2700

[52] Luo, H., Yang, T., Kwon, S., Zuo, M., Li, W., & Choi, I. (2020). Using virtual reality to identify and modify risky pedestrian behaviours amongst Chinese children. Traffic Injury Prevention, 21(1), 108–113

[53] Male, S., & King, R. (2014). Improving industry engagement in engineering degrees. Proceedings of the 25th Annual Conference of the Australasian Association for Engineering Education. Massey University.

[54] Markes, I. (2006). A review of literature on employability skill needs in engineering. European Journal of Engineering Education, 31(6), 637–650. https://doi.org/10.1080/03043790600911704

[55] Meier, R. L., Williams, M., & Humphreys, M. S. (2000). Refocusing Our Efforts: Assessing Non-Technical Competency Gaps. Journal of Engineering Education, 89(3), 377–385. https://doi.org/10.1002/j.21689830.2000.tb00539

[56] Mills, J. E. & Treagust, D. F., (2003). Engineering education: Is problem-based or project-based learning the answer? Australasian Journal of Engineering Education, (2003). https://doi.org/10.3316/aeipt.132462.

[57] Missingham, D. (2006.) The integration of professional communication skills into engineering education. Proceeding of EDU-COM International Conference, 346-357. http://ro.ecu.edu.au/ceducom/91

[58] Mohapatra, M., & Satpathy, S. (2014). English for Engineering Students: A study of the teachinglearning system in the Indian context. IOSR Journal of Humanities and Social Science. https://doi.org/10.9790/0837-19932227

[59] Morreale, S. P., Valenzano, J. M., & Bauer, J. A. (2017). Why communication education is important: a third study on the centrality of the discipline's content and pedagogy. Communication Education, 66(4), 402–422. https://doi.org/10.1080/03634523.2016.1265136.

[60] Nair, C. S., Patil, A., & Mertova, P. (2009, April 23). Re-engineering graduate skills – a case study. European Journal of Engineering Education, 34(2), 131–139. https://doi.org/10.1080/03043790902829281

[61] Nelavai, N., & Ramesh, S. (2020). An Insight into the challenges faced by First Year Engineering Students: Poor Foundational Knowledge. Procedia Computer Science, 172, 823–830. https://doi.org/10.1016/j.procs.2020.05.118.

[62] Nikolic, S., Stirling D., & Ros, M (2018) Formative assessment to develop oral communication competency using YouTube: Self and peer assessment in engineering. European Journal of Engineering Education, vol. 43(4), 538-551

[63] Nutman, P. N. S. (1987). Communication skills for engineering students: An integrative approach. European Journal of Engineering Education, 12(4), 367–375. https://doi.org/10.1080/03043798708939383

[64] Olawale, O., & Joshua, I. (2015). Employability and technical skills required to establish a small-scale automobile workshop. Journal of Education and Practice, 6(13). https://www.iiste.org/Journals/index.php/JEP/article/view/22367

[65] Owens, A. D., & Hite, R. L. (2020). Enhancing student communication competencies in STEM using virtual global collaboration project-based learning. Research in Science & Amp; Technological Education, 40(1), 76–102. https://doi.org/10.1080/02635143.2020.1778663

[66] Paretti, M. C. (2008). Teaching communication in capstone design: The role of the instructor in situated learning. Journal of Engineering Education, 97(4), 491–503. https://doi.org/10.1002/j.2168-9830.2008.tb00995.x

[67] Pollack-Wahl, J. A. (2000). It is time to stand up and communicate. Proceedings 30th ASEE/IEEE Frontiers in Education Conference, Kansas City, USA, FIG-16-FIG-21

[68] Petticrew, M., & Roberts, H. (2008). Systematic Reviews in the Social Sciences: A Practical Guide. Wiley.

[69] Richardson, S. (2020). 'Making the news: the impact of COVID-19 on international research partnerships. Ex Libris [available at https://exlibrisgroup.com/blog/covid-19-impactinternational-research-partnerships/].

[70] Riemer, M. J. (2007). Communication skills for the 21st Century engineer. Australasian. Journal of Engineering Education, 11(1), 89–100. https://research.monash.edu/en/publications/communication-skills-for-the-21st-century-engineer

[71] Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The Flipped Classroom: An Opportunity To Engage Millennial Students Through Active Learning Strategies. Journal of Family and Consumer Sciences, 105(2), 44–49. https://doi.org/10.14307/jfcs105.2.12.

[72] Sakran, T. M. E., & Prescott, D. (2013). Poster presentations improve engineering students' communication skills. International Journal of Education and Practice, 1(7), 75–86. https://doi.org/10.18488/journal.61/2013.1.7/61.7.75.86

[73] Samavedham, L. & Ragupathi, J (2012). Facilitating 21st century skills in engineering student. The journal of Engineering Education, 26(1), 37-49. https://doi.org/10.16920/jeet/2012/v25i1-4/115232

[74] Sampath, S., & Mekala, S. (2018). The impact of pedagogical intervention in developing the speaking proficiency of engineering students. Pertanika Journal of Social Science and Humanities, 26(2), 735–750.

[75] Santos, D. (2019). English language learning for engineering students: Application of a visual-only video teaching strategy. Global Journal of Engineering Education, 21.

[76] Selwyn, R., & Renaud-Assemat, I. (2020). Developing technical report writing skills in first- and second-year engineering students: A case study using self-reflection. Higher Education Pedagogies, 5(1), 19–29. https://doi.org/10.1080/23752696.2019.1710550.

[77] Shinge, J., & Kotabagi, S. (2020b). To improve presentation skills of the engineering students through a Vis-à-vis evaluation approach - A pedagogical experiment. Procedia Computer Science, 172, 350–356 https://doi.org/10.1016/j.procs.2020.05.168

[78] Suarta, I. M., Suwintana, I. K., Sudhana, F. P., & Hariyanti, K. D. (2017) Employability skills required by the 21st century workplace: A literature review of labor market demand. Proceedings of Advances in Social Science, Education and Humanities Research, 102, 337–342. http://dx.doi.org/10.2991/ictvt-17.2017.58.

[79] Tenório, Thyago & Bittencourt, Ig & Isotani, Seiji & Silva, Alan. (2016). Does peer assessment in on-line learning environments work? A systematic review of the literature. Computers in Human Behavior. 64, 94-107. https://doi.org/10.1016/j.chb.2016.06.020.

[80] Torres-Barreto, M. L., Castro Castaño, G. P., & Alvarez Melgarejo, M. (2020). A learning model proposal focused on challenge-based learning. Advances in Engineering Education, 8(2). https://doi.org/10.18260/3-1-1153-36023

[81] Tuononen, T., Hyytinen, H., Kleemola, K., Hailikari, T., Männikkö, I., & Toom, A. (2022). Systematic Review of Learning Generic Skills in Higher Education—Enhancing and Impeding Factors. Frontiers in Education, 7. https://doi.org/10.3389/feduc.2022.885917.

[82] Venkateshwara, U., & John, D. (2017). Integrating CLIL with CLT to develop speaking skills in the engineering Classroom. ESP Journal, 7, 44–53.

[83] Waitz, I. A., & Barrett, E. C. (1997). Integrated teaching of experimental and communication skills to undergraduate Aerospace engineering students. Journal of Engineering Education, 86(3), 255–262. https://doi.org/10.1002/j.2168-9830.1997.tb00292.x.

[84] Warnock, J. N., & Mohammadi-Aragh, M. J. (2015). Case study: Use of problem-based learning to develop students' technical and professional skills. European Journal of Engineering Education, 41(2), 142–153. https://doi.org/10.1080/03043797.2015.1040739

[85] Willmot, P., & Colman, B. P. (2016b). Interpersonal skills in engineering education. 27th Australasian Association of Engineering Education (AAEE) Conference.

[86] Yadav, A., Shaver, G. M., & Meckl, P. (2010). Lessons learned: Implementing the case teaching method in a Mechanical engineering course. Journal of Engineering Education, 99(1), 55–69. https://doi.org/10.1002/j.2168-9830.2010.tb01042.x

[87] Yang, L., Zhang, H., Shen, H., Huang, X., Zhou, X., Rong, G., & Shao, D. (2021). Quality Assessment in Systematic Literature Reviews: A Software Engineering Perspective. Information & Software Technology, 130, 106397. https://doi.org/10.1016/j.infsof.2020.106397.

[88] Yasmin, M., & Yasmeen, A. (2021). Viability of outcome-based education in teaching English as second language to chemical engineering learners. Education for Chemical Engineers, 36, 100–106. https://doi.org/10.1016/j.ece.2021.04.005

[89] Yeo, R. (2001). An integrative approach to the teaching of technical communication skills. Innovations in Education and Teaching International, 38(1), 93–100. https://doi.org/10.1080/147032901300002891

[90] Zaharim, A., Yusoff, Y. M., Mohamed, A., Omar, M. Z., Muhamad, N., & Mustapha, R. (2010). Practical framework of employability skills for engineering graduate in Malaysia. Global Engineering Education Conference. https://doi.org/10.1109/educon.2010.5492478.

[91] Zainuddin, S. Z. B., Pillai, S., Dumanig, F. P., & Phillip, A. (2019). English language and graduate employability. Education + Training, 61(1), 79–93. https://doi.org/10.1108/et-06-2017-0089