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The impact of continuous professional development activities on student learning outcomes and employability

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ABSTRACT

The fast development of engineering technologies forces a wide range of students to choose the technological path for their careers. Universities focus on theoretical study with limited practical exposure. To ensure students are prepared for the industry requirements, engineering universities set a core industrial experience for all students. This industrial experience aims to bridge the gap between academia and industry and to ensure students have gained the required industrial. The work in this paper highlights the importance of continuous professional development (CPD) hours for engineering students. The paper studies the impact of CPD hours on the critical skills of the student learning outcomes. A descriptive analytical methodology is applied to examine this impact. Thus, a survey of 34 questions was created and distributed to students at engineering schools in different universities across the MENA and Gulf Region. A sample of 234 answers is collected and analyzed using a statistical package for the social sciences (SPSS). The results show that students agree that CPD activities can enhance their learning outcomes, teamwork skills, public speaking, and technical competencies. The results show that student believes that CPD activity may enhance their chance of securing employment within a short timeline after graduation.

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1. INTRODUCTION

In the past few decades, the world has witnessed a surge in engineering technology across a wide range of sectors, including electrical, mechanical, and civil technologies. Education and research formed one of the main bones to advance the technologies for a safer and more comfortable life. These advancements and the merging of different sectors increased and widened the skills that are required from engineers. This widens includes the economic, security, and competency. Recent research shows the strong need for new paradigms in engineering education, research, and practice to meet the upcoming revolution requirements [1].

It is important to prepare engineering students to meet the challenges and ensure sustainable, safe, and economical projects are successfully delivered. To bridge the gap between academia and industry, engineering university introduces compulsory professional internship courses for all students before graduation. The internship plays an important and critical role in student career paths, as well as in advancing their engineering skills before graduation [2]. The completed survey highlights the importance of introducing students to practical experiences during their higher degree curriculum and how it will contribute positively to students' successful employment [3], [4]. Student internships must be strictly monitored to eliminate any mismatch between academic learning outcomes and the industry's expectations. This led to major issues with the market readiness for skilled engineers [5]. The rapid increase in technological advancements, especially the fast-approaching of Industrial Revolution 4.0, puts additional burdens on engineering universities to match the industries' expectations from graduate students [6], [7]. Nowadays, different engineering sectors are merging to meet tomorrow's technology skills [8], [9]. This merger puts a challenge on industrial internships to meet the desired requirements. Placing students in one company might not meet the required skills. Therefore, engineering universities must go outside the norm of "appointing students with an engineering company" and start looking at merging industrial appointments with continuous professional development (CPD) hours to better prepare the students for the industries. Student CPDs are used to expose students to industrial requirements and create stronger awareness among students when it comes to real-life problems. The student CPD approach is shown to be critical and important for building student soft skills that support their future career and widening their employability (EM) circle [10], [11]. CPD point is critical for professional engineers to gain critical credentials within their professional experience [12]–[14].

2. LITERATURE REVIEW

2.1. The importance of continuous professional development hours

Professional engineers need to keep their skills up to date with the latest technologies and policies. These skills cannot be updated using the engineer's everyday normal project work. The CPD points are critical for graduate engineers to achieve numerous capabilities and widen their skills. Worldwide, engineering bodies set minimum requirements for engineers to keep their credentials across a wide range of engineering services [15]. For credentials in one area of practice, the following breakdown applies to the required CPD points [16]: i) 50 hours must relate to your area of practice; ii) 10 hours must cover risk management; iii) 15 hours must be about business and management skills; and iv) 75 hours must cover a range of activities relevant to your career interests.

To practice engineering in Australia as a self-consultant or run a consultancy firm, professional engineer registration is required for the state where the practice is intended. To get and maintain this credential, professional engineers must maintain a minimum set of CPD points per year [17]. Similarly, engineers will find that CPD points are critical for the UK Engineering Council, and for the American Society of Civil Engineers (ASCE) [18], [19]. Based on this section, it is clearly shown that without CPD points, graduate and professional engineers will have limitations when it comes to professional practices within their field experience. From this approach, and to exceed expectations when it comes to students' internship objectives, students must practice the CPD approach before graduation. Also, exposing students to this process will advance their technical, communication, and networking skills. It is worth noting that for professional engineers, it is not acceptable to submit works from their everyday projects to keep their credentials. This approach should also be applied to student internships by mixing field work and CPD skills.

2.2. List of continuous professional development activities

Industrial skills are critical for all students. It is the university's responsibility to ensure students' skills meet the industry's expectations. This can be achieved by ensuring students' internship and student CPD hours meet the latest technological trends for students' degrees. Universities must set the minimum boundaries and have strict monitoring systems for student professional experience. The proposal under this paper includes the following two sectors: regular students' internship and student CPD hours.

2.2.1. Regular student's internship

Engineering degrees worldwide have set a core course for internship. As part of the course requirements, students source an internship opening at an approved company within their field of study. The university will monitor students' performance and review students' submissions as part of their internship progress. Universities set a list of benefits and learning outcomes of the internship course [20]. There are several lists of benefits and learning outcomes for an Australian university, the following are the internship benefits [21]. The opportunity to receive guidance and feedback from industry professionals [22], [23].

- Development of desirable work habits and attitudes while learning what it takes to become responsible and accountable employees.
- The chance to explore and verify career interests and competencies in the workplace environment.
- Enhance students' ability to develop a strategic career plan for continuing education and employment.
- Provide the opportunity for classroom experiences to become more relevant and meaningful.
- Promote personal success and achievement which can motivate the student and their colleagues to higher levels of performance in their studies.

2.2.2. Student continuous professional development hours

Under this paper, it is recommended to have the student's CPD hours cover between 25% and 50% of the student's overall internship hours. The university is responsible for setting acceptable CPD boundaries without putting an additional burden on students' educations [7]. The paper proposes the following categories for student CPD: short courses, on-campus events, research, or innovation fairs, attending external professional presentations, student professional clubs, and limited virtual industrial experience training. The university must ensure the contents of each CPD point can be linked to the desired outcomes, which could be the agreed benefits, learning outcomes, or approved CPD types within the state or country [24], [25].

Based on the current literature review and the current practices across the planet, professional engineers must maintain a set of CPD points to keep their credentials. Also, these CPD points are governed by the license policies. Furthermore, engineers cannot satisfy the CPD requirements by completing work under their normal duties in their assigned roles. Driven by the fact that internship is to expose students to the industry requirements and to advance their EM, universities must mix the student internship between regular fieldwork experience and CPD hours. This allows the students to blend with the professional requirements and to gain critical soft skills which is important for students' future career development. Students attending an industrial internship for numerous weeks will learn a fixed set of skills. Increasing the number of weeks for the student at the same location will not expand student skills to other critical skills. Therefore, the internship needs to capture a wide range of activities that include field technical skills, communication, presentation, working on their own, and dealing with the latest technologies and policy news. Finally, the student CPD points will extend the student opportunity beyond EM and open the door to entrepreneurship. It allows the students to complete research projects with industrial support and constraints. This approach advances engineering degree outcomes and supports tomorrow's technological manpower. Most universities offer the mentioned activities at their campuses. It is only required for the internship coordinator to re-arrange and manage the activity's contents to meet the desired learning objective [24], [26], [27].

The paper set the minimum boundaries for engineering institutions to mix the standard industrial experience with CPD hours. The paper contains the link requirements between different CPD types, student learning outcomes (SLO), and the main university roles. This study will answer the following research question: what is the impact of CPD activities on the SLO? (R1). From this question, other research questions can be deduced: i) what is the impact of CPD activities on the student technical competencies? (R11); ii) what is the impact of CPD activities on the student teamwork skills? (R12); iii) what is the impact of CPD activities on the student’s public speaking skills? (R13); iv) what is the impact of CPD activities on the student learning performance? (R14); and v) what is the impact of CPD activities on the student EM? (R15).

3. RESEARCH METHOD

The main objective of this section is to examine students’ opinions about CPD activities and their impact on their learning outcomes. A descriptive analytical methodology will be applied. The following variables will be considered. The independent variable that represents the CPD activities. Dependent variable that covers SLO. For this variable, the following dimensions will be examined: technical competencies (TC), teamwork skills (TW), public speaking (PS), learning performance (LP), and employability (EM). Based on these variables, the conceptual framework can be created as per Figure 1. From the figure, the following hypothesis can be derived: there is a significant impact of CPD activities on SLO (H1). From H1, other hypotheses can be deduced: i) there is a significant impact of CPD activities on the student’s TC (H11); ii) there is a significant impact of CPD activities on the student’s TW (H12); iii) there is a significant impact of CPD activities on student PS (H13); iv) there is a significant impact of CPD activities on student LP (H14); and v) there is a significant impact of CPD activities on student EM (H15). To examine the hypothesis, a descriptive-analytical methodology will be used. Thus, a questionnaire of 35 questions is built to represent all variables as seen in Table 1.

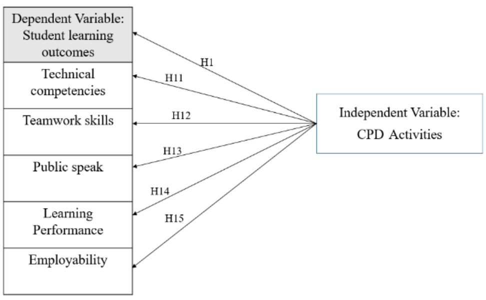

Figure 1. Conceptual framework

Table 1. Variables and dimensions of the questionnaire

Variables	Dimension	Number of questions
Dependent variable: SLO	Personal information	3
	Technical competencies	5
	Teamwork skills	6
	Public speaking	5
	Learning performance	5
	Employability	5
Independent variable: CPD activities		6
Total		35

4. RESULTS AND DISCUSSION

The questionnaire was distributed to a convenience sample of 300 engineering students from different universities within the MENA and Gulf Region. Only 233 answers were collected. The response ratio is shown in (1):

$$Ratio = \frac{Collected\ Answers}{Distributed\ Answers} = \frac{233}{300} = 0.78 \quad (1)$$

Thus, 78% of the sample answered the questionnaire and the result was good.

The Likert five adopted in this study can be interpreted as 1=Strongly disagree (SD); 2=Disagree (D); 3=Neutral (N); 4=Agree (A); 5=Strongly agree (SA). The questionnaire is distributed to a convenience sample of engineering students in Dubai. The collected answers are analyzed using SPSS. To evaluate the reliability of the questionnaire, Cronbach's alpha was employed. The Cronbach's alpha of the study values is between 0.784 and 0.83 which represents that the internal consistency is good. The average Kaiser-Meyer-Olkin (KMO) value of the study variables is 0.81. According to these values, the sample is suitable for the factors of the study [28].

4.1. Demographical result

Table 2 shows the sample distribution according to gender. According to this table, 57% of the sample are male. However, 43% of the sample are female. This is normal for a technical major like engineering. It also shows the sample distribution according to age. Only 10.7% of the sample are master level. This is a normal result. Indeed, almost all engineering students like to work more in technical areas than continue their research studies. Table 2 also shows the sample distribution according to major. As illustrated in this table, the sample is well distributed between the different main majors of engineering school. The sample is well distributed between the different main levels of engineering schools with a minimum number of master students. This is a normal result. Indeed, almost all engineering students like to work more in technical areas than continue their research studies.

Table 2. Sample distribution according to gender, age, major, and level

Value		Number
Gender	Female	100
	Male	133
	Total	233
Age	18-20	108
	20-24	100
	24-27	25
	Total	233
Major	Civil	75
	Electrical	53
	Mechanical	47
	Biomedical	58
Level	Senior	65
	Junior	81
	Sophomore	54
	Master	33

4.2. Descriptive analysis

In this part, a descriptive analysis of the collected answers will be performed. Table 3 shows an interpretation of the mean compared to the Likert gradient. Table 4 shows the mean (M), standard deviation (SD), Skewness (SK), and kurtosis (KU) for the questions in the survey. According to this table, the questions associated with "TeC" have mean values that change between 2.704 and 4.056. They are below to range of moderate and strong. Thus, the students strongly agree that during the CPD activities, they will carry out administrative work without performing real technical work. However, the sample agreed slightly that they would participate in technical and professional tasks during their CPD activities. Indeed, this is common in Arabic countries as companies do not depend on internships.

The questions related to "TW" have means between 2.498 and 3.858. These means below to range moderate and strongly agree. Therefore, the students of the sample agree that they will acquire TW without resolving real technical problems. The results of these questions are consistent with the result of the dimension TC as the students did not believe that they would join real technical and professional tasks during their CPD activities.

Table 3. Likert scale with their meaning

	SD	D	N	A	SA
Scale	1-1.8	1.81-2.6	2.61-3.4	3.41-4.2	4.21-5
Meaning	Very weak	Weak	Moderate	Strong	Very strong

Table 4. Mean, Standard deviation, skewness, and Kurtosis values of the questions

Variable	Code	Question	M	SD	SK	KU
TC	TC1	During CPD, I will learn to accomplish safety tasks in an industrial working environment.	3.322	0.6658	-0.733	1.001
	TC2	I will achieve technical tasks related to my specialized area.	3.338	0.7172	-0.822	1.139
	TC3	I will Learn how to use modern computer-aided tools.	3.318	0.5512	-0.936	1.456
	TC4	During the internship, I will be able to use electronic devices, sensors, and other engineering components.	2.704	0.6841	-0.711	1.119
	TC5	During CPD activities, I will carry out only administrative work without performing real technical work	4.056	0.5504	-0.717	1.328
TW	TS1	During my internship, I will be a part of a professional team.	3.721	0.8010	-0.800	1.721
	TS2	I will enjoy teamwork.	3.425	0.8172	-0.925	1.451
	TS3	CPD activities will enhance my TW.	3.828	0.7045	-0.811	0.852
	TS4	During the internship and other CPD activities, I will learn how to work in a team and how to exchange information to accomplish tasks.	3.858	0.3494	-0.772	0.902
	TS5	During the internship and other CPD activities, I will learn how to cooperate to deal with technical problems.	2.498	0.5012	-0.912	1.339
	TS6	I will learn to bring conflict into the open so it can be discussed and resolved.	3.142	0.5801	-0.808	1.025
	TS7	I will be an effective member of the team.	3.785	0.4114	-0.807	1.142
PS	PS1	CPD activities will make me quieter in PS.	3.176	0.9689	-0.912	1.311
	PS2	CPD activities will help me reduce my errors during PS.	3.536	0.7250	-0.744	1.528
	PS3	Attending external and professional conferences will enhance my experience in PS.	2.597	0.8562	-0.758	1.112
	PS4	CPD activities will enhance my experience in preparing for PS.	2.506	0.8716	-0.714	1.312
	PS5	CPD activities will enhance my foreign language and make me more confident in PS.	4.082	0.7641	-0.798	1.478
LP	LP1	CPD activities will demonstrate the importance of the materials in my professional career.	3.957	0.9204	-0.833	0.963
	LP2	I will be interested to get more grades to participate in CPD activities.	4.172	0.7632	-0.857	0.982
	LP3	CPD activities will provide scientific and technical explication that makes the materials more interesting.	3.885	0.5535	-0.889	1.001
	LP4	CPD activities will make the materials more interesting.	3.987	0.9872	-0.826	1.889
	LP5	CPD activities enhance my research and critical thinking.	4.495	0.9474	-0.743	1.246
EM	EM1	Assisting in internships and other CPD activities will enhance my chances of getting good job opportunities.	3.755	0.9849	-0.900	1.369
	EM2	CPD activities will enhance my skills and prepare me well for Job interviews.	3.712	0.6491	-0.811	1.582
	EM3	CPD activities will help me in creating a good CV.	3.137	0.6631	-0.665	1.002
	EM4	CPD activities will improve my search for job skills.	3.459	0.7820	-0.617	1.009
	EM5	CPD activities will assist me in improving my skills during my professional career.	4.137	0.6936	-0.809	1.027
CPD activities	CPD1	CPD activities will include topics that are relevant to your interest field.	3.280	0.3852	-0.976	1.014
	CPD2	CPD activities are essential tasks during your university studies.	3.948	0.9768	-0.649	1.368
	CPD3	CPD activities will enhance your academic experience.	4.142	0.9677	-0.816	1.819
	CPD4	CPD activities will prepare you for your professional career.	4.253	0.8907	-0.887	1.785
	CPD5	CPD activities can reduce the gap between theory and practical problems.	3.524	0.8411	-0.978	1.012
	CPD6	CPD activities can enhance my confidence.	3.857	0.9856	-0.917	0.723

The questions related to the dimension PS have a mean between 4.082 and 2.506. This means below the range of moderate and strongly agree. Therefore, the sample agrees that CPD activities are important for them to be more confident during PS. However, they slightly agree that these activities help them in preparing for PS. This is common, as PS in a professional career differs from PS during university activities. The questions related to the LP dimension have a mean between 3.885 and 4.495 (moderate and strongly agree). Therefore, the sample agrees that the CPD activities link the content of the materials to real-world problems and enhance their critical thinking skills. Indeed, engineering students often like to do more practice and they always search to link the theory to real cases. The questions related to the EM dimension have a mean between 3.137 and 4.137 (moderate and strongly agree). Thus, the sample agrees the CPD activity will enhance their chance to get a good job as they have acquired more technical skills than any other fresh graduate students. However, they Slightly agree that CPD activities will enhance their capability to search for a job. The question related to CPD has a mean between 4.253 and 3.280 (moderate and strongly agree). Therefore, students of the sample agree that CPD activities will prepare than for professional careers. However, the sample slightly agrees that all topics of CPD are interesting. This is normal as each student has his interesting topics. As illustrated in Table 4, the SD of all questions is less than 1. Thus, there is a small deviation of the answers from the mean. The Skewness values are negative. Thus, the distribution is negatively skewed. For KU, the value is greater than +1.0, the distribution is leptokurtic.

4.3. Hypothesis analysis

Table 5 shows the Pearson correlation between the different variables of the study. As shown in this table, the sig values are less than 0.05. Thus, there is a significant relationship between CPD activities and SLO with their dimensions (EM, TW, PS, LP, TC). The person correlation values are positive; thus, the relationship is positive. Therefore, more CPD activities imply higher employment abilities, teamwork skills, public speaking skills, learning performance, and technical competencies. In addition, the values of the Pearson correlation change from 0.621 and 0.732. Thus, the correlation is high for teamwork skills and moderate for the other dimensions.

An updated version of the univariate analysis of variance (ANOVA) is called multivariate analysis of variance (MANOVA) [29]. An independent grouping of variables can examine the statistical link between one continuous dependent variable using ANOVA. The MANOVA, on the other hand, broadens this testing by taking into account multiple dependent variables. To demonstrate the relationship between "CPD" and "Student learning outcomes," the author uses One-Way MANOVA to test the main hypothesis and its related sub-hypotheses in this section. The MANOVA test result for this investigation is displayed in Table 6. As illustrated in this table, all partial Eta squared is greater than 0.14. Thus, there is a significant impact of CPD activities on the student learning outcomes according to the sample [30].

According to Table 6, the student's technical competencies are impacted by CPD. Since Eta is equal to 0.67, a positive is present. The CPD activities used resulted in 0.448 changes in student technical competencies, as measured by Eta Squared. Sub-hypothesis H11 is supported by this value. The student's teamwork skill is impacted by CPD. Since Eta is equal to 0.72, a positive is present. The CPD activities used resulted in 0.518 changes in student teamwork skills, as measured by Eta Squared.

Sub-hypothesis H12 is supported by this value. The student's public speaking skill is impacted by CPD. Since Eta is equal to 0.68, a positive is present. The CPD activities used resulted in 0.5462 changes in student public speaking skills, as measured by Eta Squared. Sub-hypothesis H13 is supported by this value. The student learning performance is impacted by CPD. Since Eta is equal to 0.68, a positive is present. The CPD activities used resulted in 0.5462 changes in student learning performance, as measured by Eta Squared. Sub-hypothesis H14 is supported by this value. The student's employability is impacted by CPD. Since Eta is equal to 0.71, a positive is present. The CPD activities used resulted in 0.504 changes in student employability, as measured by Eta Squared. Sub-hypothesis H15 is supported by this value.

Table 5. Pearson correlation values

Dependent variable	Correlations	Independent variables					
		SLO	EM	TW	PS	LP	TC
CPD	Pearson correlation	0.672	0.650**	0.732**	0.686**	0.683**	0.621**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	.023
	N	233	233	233	233	233	233

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed)

Table 6. Compare means

Measures of association	Eta	Eta squared
CPD*TC	0.67	0.448
CPD*TM	0.72	0.518
CPD*PS	0.68	0.462
CPD*LP	0.68	0.462
CPD*EM	0.71	0.504

5. CONCLUSION

Student internship is critical to advance student engineering skills and their job opportunities. Nowadays, the advances in technology are going exponentially which puts constraints on a single internship to deliver the required learning outcomes to students. Following the student CPD approach supports universities in meeting the industry's power skills expectations and supports students' EM path. Universities must set a list of on-campus and off-campus activities that student must follow to achieve their required CPD points. As shown in this paper, most of the proposed activities are already being hosted at university campuses. This approach not only benefits students' EM, it will also advance the university's stand with the industries due to the valuable skills that are being shared between employers and academics. In this study, the authors adopt a descriptive-analytical methodology to examine the opinions of engineering students in the MENA and Gulf Region about CPD activities. Two main variables are used: CPD activity (independent variable) and SLO (dependent variable). Five dimensions of the dependent variable were used: TC, TW, PS, LP, and EM. Based on these variables a questionnaire of 35 questions was built and distributed to 300 convenience sample of students. Only 233 answers were collected. The gathered answers were analyzed using SPSS. The results show that there is a positive impact of CPD on SLO. This result is logical. By adopting adequate CPD activities, the student's TC, TW, PS, and learning outcomes will be improved. Also, their EM chance will become better. After performing this study, the authors suggest that CPD activities should be mandatory in the Arabic university. In addition, companies should involve internships in professional and technical tasks.

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