Teachers' Experiences of Continuous Professional Development and Its Influence on Teaching Practices in Engineering Education

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Abstract

Continuous Professional Development (CPD) has become a key component for improving engineering education in the context of a changing educational environment, where new pedagogical and policy approaches such as the NEP 2020 are constantly reshaping the landscape. There are numerous research studies examining the results of CPD, but very few of those studies have investigated the lived experiences of teachers and the actual impact of CPD on classroom practice. The present study is aimed to examining the experience of the engineering faculty members in relation to CPD and how this experience affects their teaching. The design for this research is qualitative with phenomenological approach. Twenty engineering faculty members were interviewed using a semi-structured interview process and the data was analysed thematically. The results showed that CPD has a significant impact on pedagogical change, effectiveness of teachers and student engagement. However, the challenges associated with CPD learning such as workload, time availability and institutional support can be encountered when implementing CPD learning. In addition, the study underscores the importance of contextually and practice-based professional learning programs. The study indicates that although CPD is a requirement that must be fulfilled to improve teaching, it is not just the hours of CPD that are important, but the quality, relevance and institutional support for the CPD. The results offer important implications for policy makers, institutions and teachers to create more meaningful and durable CPD programs.

Keywords: Continuous Professional Development, Teaching Practices, Engineering Education, Pedagogical Transformation, NEP 2020

Introduction

In the context of Higher Education, Continuous Professional Development (CPD) has become an important element of the quality enhancement process, especially in engineering institutions where knowledge and pedagogical expectations in the disciplines are continuously changing as a result of the fast rate of technological change. In recent years, engineering educators have not only been expected to have extensive knowledge in their technical fields, but also to have a keen understanding of new teaching methods that facilitate students to learn independently, to think and act like engineers, to work cooperatively, and to gain industry-related skills. In the context, CPD becomes a critical strategy for teachers to enhance their pedagogical skills and align their practice with the changing demands of education (Chen et al., 2024; Ferguson, 1998).

Learner-centred pedagogy is the current focus in engineering education and the importance of faculty development programmes like workshops, Faculty Development Programmes (FDPs), seminars, trainings and reflective teaching has been emphasised. The literature suggests that professional learning can also foster pedagogical change, as it can empower educators to shift away from lecture- and content-driven teaching to active and experiential learning (Borrego & Henderson, 2014; Butcher & Stoncel, 2012). Research also shows that CPD increases teachers' confidence, improves the clarity of what they teach and increases engagement within the classroom, which in turn has an impact on the overall effectiveness of teaching (Chalmers & Gardiner, 2015; Daumiller et al., 2021).CPD is more important in the field of Engineering Education where teachers are often faced with issues related to curriculum innovation, laboratory instruction, outcome-based education and using modern technology in teaching learning. Good professional development programs enable teachers to match their teaching methods to the new expectations of education and occupational needs (Jørgensen & Kofoed, 2007). Additionally, professional learning experiences are conducive to reflective teaching approaches and promote ongoing enhancement in instructional practices (Christoforou & Yigit, 2008).Although CPD is known to be important, there are a number of studies that have identified the barriers to effective CPD implementation, such as institutional barriers, workload pressures, lack of support systems, and lack of opportunities for continuing professional development (Williams, 2020). The existing literature has largely concentrated on quantitative analysis results on the outcomes of the CPD, but there is not much consideration of the experience and perceptions of teachers about the impact of CPD on their classroom practices in engineering education environment.

Hence the present study explores the insight of teachers in relation to Continuous Professional Development and how it impacts on their teaching in engineering education. The study will be qualitative to gain a deeper understanding of faculty perspectives on CPD experiences, how they are translating the learning into their classroom work, and how they are managing the challenges arising from the process. The study will aid the discussion around faculty development and will inform the development of more relevant and context-specific faculty development programs in engineering schools.

Review of Related Literature

The need for Continuous Professional Development (CPD) to improve engineering education teaching methods has been pointed out by recent studies. A systematic review conducted by Chen et al. (2024) established that CPD plays an important role in pedagogical innovation and in higher engineering education in teaching quality. Likewise, Nassereddine and Nassreddine (2024) found that CPD has a positive impact on student learning outcomes, employability skills, and faculty teaching capabilities. Zhou et al. (2023) conducted a meta-analysis in turn, and found that professional development programs significantly positively impact classroom effectiveness and teacher self-efficacy in STEM. Additionally, Rich et al. (2021) showed that ongoing CPD enhances teachers' confidence and practices, especially in new areas like ICT.For the higher education sector, Daumiller et al. (2021) highlighted that the motivation and involvement in professional training are crucial to achieving good learning outcomes and pedagogical skills for teachers. Also, Mesutoglu and Baran (2020) pointed out that when a program of CPD includes collaborative learning, hands-on experience and application in the classroom, it is more effective. In a systematic review, Williams (2020) revealed that CPD is an important element in the facilitation of technology-enhanced learning and innovative pedagogy. Previous research also confirms the impact of CPD on improving quality of teaching. They identified that professional development programs can be a tool to incorporate the concepts of sustainable development in engineering

programs (Pérez-Foguet & Lazzarini, 2019). Similarly, Zamora-Polo et al. (2019) have shown that CPD programs improve engineering educators' sustainability oriented teaching skills.

Professional development impacts on foundational studies in higher education as well, as evidenced by numerous studies. In their work, Borrego and Henderson (2014) found that structured professional development practices are foundational to significantly improving evidence-based teaching practices. Chalmers and Gardiner (2015) also stated that Academic Development Programs help in the areas of teaching effectiveness and faculty development. Butcher and Stoncel (2012) also showed that teachers' involvement in professional training programmes leads to greater confidence and use of innovative pedagogical practice. Pedagogical training results in the use of student-centered pedagogical methods and reflection (Postareff et al. 2007). Christoforou and Yigit (2008) in the engineering field emphasised the benefit of continuous professional training for instructional planning and delivery in the classroom. In addition, Jørgensen and Kofoed (2007) stressed the importance of CPD for the promotion of CII in engineering educators. While a little earlier, Mouza (2009) offered valuable insight into what it takes to achieve long-term professional development for ongoing gains in teaching practices, especially the use of technology.

Research Gap

There is substantial evidence in the literature indicating that Continuous Professional Development significantly contributes to improve teaching efficacy. Many studies have employed quantitative or mixed-methods designs that have investigated measurable outcomes such as self-efficacy, performance, and student achievement. The lived experiences, perceptions, and contextual realities of engineering educators about CPD have been studied only somewhat. Especially, there has been no qualitative study that investigates the meaning-making, taking-up and incorporation of professional development learning experiences in teacher's classroom activities. Accordingly, the present study aimed to fill this gap by using a qualitative approach to know the teachers' reflections of CPD and its impact on teachers' practices in engineering education.

Objectives of the Study

1. To explore the experiences of engineering faculty regarding Continuous Professional Development (CPD) programs.
2. To examine how CPD influences teaching practices among engineering educators.
3. To identify the challenges faced by faculty in implementing CPD learnings in classroom settings.

Research Questions

1. How do engineering teachers experience Continuous Professional Development programs?
2. In what ways do CPD programs influence their teaching practices?
3. What challenges do teachers encounter while applying CPD learning in their classrooms?

Methodology

Research Design

This research consists of qualitative research design, in order to explore the experiences of the engineering faculty about Continuous Professional Development (CPD) and its effect on the teaching practices of engineering faculty. A qualitative approach is an appropriate way because it supports a deep understanding of participants' experiences, perceptions and interpretations within their natural teaching environments.

Participants and Sampling

The study has been carried out by engineering faculty-staff of Higher Education Institutes. A total of 20 participants were selected through purposive sampling and all were experienced in participating in CPD events like Faculty Development Programs (FDPs), workshops, seminars or training sessions. Participants were from different areas of Engineering to get a different perspective.

Data Collection Tool

Data was gathered through a semi-structured interview schedule, which included questions to get the participants experience of CPD, how it affected their practice and barriers to CPD implementation. Open-ended questions were used in the interviews to allow participants to articulate their views.

Data Collection Procedure

All participants were provided informed consent beforehand and confidentiality and voluntary participation was ensured. Interviews were held individually, face-to-face and online, depending on the availability of participants. The interviews were about 45-60 minutes long, giving participants enough time to think about and articulate their experiences of Continuous Professional Development in depth. Probing questions were used to dig deeper into the beliefs, perceptions, challenges and professional changes that participants had. All interviews were audio taped and field notes recorded for any non-verbal information or observations in context, with participants' permission.

Data Analysis

The recordings from the interviews were taken verbatim immediately following data collection. The transcripts were read over and over again to immerse oneself in the data and to grasp participants' lived experiences. Coded meaningful statements and significant expressions were identified. The related codes were subsequently organized into groups, which had similar meanings for participants. Finally, these categories were aggregated into more general interpretative themes, which capture the core of engineering faculty members' experiences of Continuous Professional Development and how Continuous Professional Development affects their teaching. Transcripts were continually compared to themes to keep the interpretations grounded in the participants' narratives throughout the analysis.

Analysis and Interpretations

The data collected through semi-structured interviews were analyzed using thematic analysis. The analysis resulted in six major themes reflecting participants’ perception on Continuous Professional Development (CPD) and its influence on teaching practices in engineering education.

Theme	**Codes**	**Description**	**Participants References**	**Sample Participant Quote**
1. CPD as a Catalyst for Professional Identity Reconstruction	FDP participation, workshops, training exposure, peer interaction	Participants reported engaging in various CPD activities such as workshops and FDPs, which provided exposure to new teaching strategies and opportunities for professional interaction.	*P-3,P-5,P-9, P-12, P-17*	*"I have attended several FDPs, and they helped me learn new teaching methods and interact with faculty from other institutions."*
2. From Content Delivery to Learner-Centred Pedagogy	Interactive teaching, student-centred approach, innovative methods, lesson redesign	CPD experiences facilitated a shift from traditional lecture-based teaching to more interactive, student-centred approaches.	*P-1,P-4,P-7,P-11-P-15,P-18,P-20*	*"After attending training, I shifted from only lecturing to including discussions and activities in my classes."*
3. Translating Professional Learning into Classroom Reality	Application of knowledge, experimentation, adaptation, practical teaching	Teachers attempted to apply CPD learning in classroom settings by adapting new strategies according to student needs and subject requirements.	*P-2,P-5,P-6,P-14,P-19*	*"I try to implement what I learn in workshops, but I modify it based on my classroom situation."*
4. Rebuilding Confidence through Continuous Learning	Confidence, clarity, engagement, improved delivery	Participants perceived an improvement in their teaching effectiveness, including better clarity, confidence, and student engagement.	*P-7,P-9,P-14,P-18*	*"My confidence has increased, and students seem more engaged after I changed my teaching style."*
5. Negotiating Institutional Constraints	Time constraints, workload, lack of resources, institutional support	Despite positive experiences, participants faced challenges such as limited time, heavy workload, and lack of institutional support in	*P-1,P-4,P-8,P-10,P-13,P-17,P-19*	*"We learn many things in training, but due to workload, it is difficult to apply everything."*

Theme	Codes	Description	Participants References	Sample Participant Quote
		implementing CPD learning.		
6. Envisioning Meaningful Professional Development	Practical training, relevance, follow-up support, continuous learning	Participants emphasized the need for more practical, context-specific CPD programs with continuous support mechanisms.	*P-3,P-9,P-16,P-18,P-20*	*"CPD programs should be more practical and related to our teaching context."*

Interpretation of Findings

The results obtained in the study are outlined under six key themes, all of which relate to the research objectives and research questions on teachers' experiences of Continuous Professional Development (CPD) and how this affects teachers' practices in engineering education.

Theme 1: CPD as a Catalyst for Professional Identity Reconstruction

The analysis reveals that engineering faculty actively participate in various CPD activities such as workshops, Faculty Development Programs (FDPs), seminars, and training sessions. These experiences are seen as good opportunities for professional learning, seeing new ideas and working with others. Teachers perceive CPD as a process rather than a 'formal' requirement, and regard CPD as a process of ongoing professional development. This directly answers the first research question by highlighting the positive and enriching experiences of teachers' CPD.

Theme 2: From Content Delivery to Learner-Centred Pedagogy

One of the main benefits of CPD is the change in teaching styles. Participants indicated that they were moving away from the traditional lecture approach to a more interactive, student-centred approach. These include the use of discussions, collaborative learning, real-life examples or problems solving activities. This theme shows that CPD can be a catalyst for pedagogical change, thereby addressing the second objective of the research which focuses on the impact of CPD on teaching.

Theme 3: Translating Professional Learning into Classroom Reality

The results suggest that teachers make proactive efforts to apply the knowledge and skills gained from CPD in the classroom. But it is not consistent: it is changeable, it is situational. Teachers adapt and innovate new strategies to meet student needs, subject requirements and institutional conditions. This is indicative of reflective teaching practices where teachers critically analyse and modify their teaching processes to produce good learning outcomes.

Theme 4: Rebuilding Confidence through Continuous Learning

The teachers felt they had made significant improvements in their teaching capabilities following CPD. They indicated greater confidence, clarity of content delivery, improved

communication and increased student engagement. This theme supports the concept that CPD plays a major role in the professional competence of educators and in the quality of their teaching.

Theme 5: Negotiating Institutional Constraints

There are a number of challenges that may prevent CPD learning from being implemented effectively. The teachers found that their workload, time constraints, institutional support and resources were limiting factors. The barriers that filter and impedes the movement of professional learning to classroom practice is the third research question that seeks to understand the challenges of the teachers, these barriers are being addressed.

Theme 6: Envisioning Meaningful Professional Development

The results also indicate the need for more context-specific and practical CPD programs. Emphasis was placed on the need to connect professional development to actual classroom contexts and provide support following the professional development to make it sustainable. This indicates that the impact of CPD is dependent on both the content and the relevance and applicability of the CPD. The theme based interpretation provides a general impression that CPD has a transformative effect on engineering education teaching practices. It improves pedagogical practices and teaching, but the success is largely dependent on its contextual relevance and institutional support, and thus it serves all research aims and research questions.

Discussion

This research study contributes to the existing studies in higher education and provides the important insight into the role of continuous professional development (CPD) in influencing Teaching Practices of Engineering Faculty. The results confirm the importance of CPD as a key instrument for professional growth and pedagogical development, consistent with the findings by Chen et al. (2024), Nassereddine and Nassreddine (2024) and MacLeod (2020) who highlighted the significance of CPD in enhancing teaching quality and student outcomes. In like manner, Desimone (2009) and Guskey (2002) state that high quality professional development leads to significant transformative changes in teachers' knowledge, skills and classroom practices. In this study, the theme of pedagogical transformation that is, teachers' transition from traditional, lecture-based instruction to interactive, student centred instruction corroborates previous studies by Borrego and Henderson (2014) and Postareff et al. (2007). The studies mentioned above show that CPD promotes the use of evidence-based teaching practices, which improves student engagement and learning effectiveness. Further, the enhancement of the quality of teaching experienced by participants aligns with the findings of Daumiller et al. (2021) and Chalmers and Gardiner (2015), which revealed that professional development programs led to improved confidence, clarity and pedagogical skills. The research is also applicable to the body of literature because of its emphasis on the adaptive nature of classroom implementation. The teachers do not directly mimic the CPD learning, but adapt it in accordance with the contextual realities, as suggested by Schön (1983) and confirmed by Avalos (2011) in the model for reflective practice. This means that CPD is not simply a transfer of knowledge but a reinterpretation of knowledge in context and a process of professional reflection. The results also show that there are ongoing issues, including workload, time constraints and a lack of support from institutions that hinder effective implementation of CPD learning. These barriers have been extensively reported in the literature such as the work of Williams (2020) and Opfer and Pedder (2011) which focus on structural and organizational barriers to professional development. There is a disconnect

between participating in CPD and applying what is learned in the classroom, consistent with the findings of Darling-Hammond et al. (2017) and Timperley (2011), which indicate that more supportive institutional environments are needed to make CPD more effective.

In addition, the study highlights the need for contextually relevant and practice-oriented CPD. This is consistent with the findings of Desimone and Garet (2015), Kennedy (2016) and Borko (2004) who support models of ongoing, collaborative and contextually relevant professional development. The area of engineering education in particular demands the development of CPD programs that are relevant and practically applied as highlighted by Jørgensen and Kofoed (2007) and Zamora-Polo et al. (2018).As a whole, the current study contributes to the previous research by providing a qualitative insight into teachers' experiences of CPD in engineering education. It reveals that CPD can be a very powerful catalyst for change in classroom practice and can improve the effectiveness of teaching but this will depend on a range of contextual factors, institutional support and the relevance of CPD training programmes. The results will serve as inputs to the broader conversation on enhancing faculty development for improved educational outcomes.

Findings of the Study

1. The study identified Continuous Professional Development (CPD) as a powerful professional learning experience helping engineering faculty to re-imagine their professional identity. The participants saw CPD as an ongoing process of learning that enhanced their sense of responsibility, reflecting on their practice and a commitment to teaching excellence.

2. The results highlighted that there was a significant change from teacher centred to learner centred pedagogical approaches as a result of the CPD. Incorporation of collaborative learning, problem-based learning, experiential activities, and interactive classroom discussions were reported by faculty members and led to increased student participation and engagement.

3. The study revealed that teachers made an effort to make their professional learning translate into classroom practice by adapting the newly acquired pedagogical strategies to meet the needs of various learners, the goals of the course and the institutional context. This was illustrated by reflective decision making rather than mechanical implementation of training outcomes.

4. Results indicated that the continuous engagement in CPD increased the teachers' professional confidence, instructional ability, teaching communication and embedding of new teaching skills. These improvements were seen by the participants as directly impacting upon more effective teaching and meaningful learning experiences for students.

5. This study found that reflective practice was a key output of CPD. Instructors regularly reviewed their own instructional practice, reflected on their teaching experiences, and made ongoing adaptations to their pedagogy to enhance the classroom and student outcomes.

6. The participants were aware of the value of CPD, but they faced a number of institutional obstacles that hindered the effective application of CPD. The major challenges to professional learning in classroom practice identified are: heavy teaching load, administrative roles & responsibilities, lack of institutional support, lack of resources and lack of follow-up mechanisms.

7. Further, it was found that the participants were fond of the CPD programmes which were discipline specific, practice based, collaborative and relevant to real classroom situations. The

importance of mentoring, peer learning, ongoing feedback and relevance over the requirement for mandatory professional development was stressed by faculty members.

In summary the study showed that the effectiveness of Continuous Professional Development has a range of implications beyond the individual's skills as a teacher. Participants felt that CPD could act as a driver for reflective teaching, pedagogical innovation, professional development and educational quality. Long-term impacts, however, rely on the quality, context, commitment, and support of engineering education.

Educational Implications

The results of this research are relevant to engineering education with regards to teacher improvement and better teacher development systems. The study indicates the importance of continuous and systematic CPD programmes, rather than a single training session. Institutions should develop ongoing professional development program design that encourages active involvement, reflection and ongoing pedagogical growth. Regular follow-up sessions and mentoring support can enhance the practical application of learned skills.

Second, the changing instructional paradigm to students' centred learning and interactive learning has highlighted and promoted the need for CPD programmes to focus on innovative pedagogy including experiential learning, problem based learning, and collaborative teaching approaches. This will help teachers to design better and interesting learning environments in the field of engineering education, thus enhancing the engineering education outcomes.

Thirdly, the study highlights the need for contextual and practice-based CPD. Professional development should be customized to the needs of engineering faculty and includes actual classroom challenges as well as discipline-specific examples and hands-on training. These context-related programs may fill the gap between theory and practical use in the classroom.

Moreover, the problems highlighted in the study show the requirement for better institutional support systems. Schools should ease the burdens of administration, equip teachers with the necessary resources, and foster an atmosphere that supports experimentation with innovative approaches. Further incentives and recognition for participation of faculty in CPD can further motivate faculty engagement. Lastly, we need to embed CPD in institutional processes and systems, and make professional development a standard part of faculty employment and promotion. In summary, the implications highlight the importance of effective CPD in supporting the quality of teaching and improving the continuous learning in engineering education.

Conclusion:

The findings of the present study support the need for Continuous Professional Development (CPD) in enhancing the quality of teaching in engineering education that should align outlook of the “National Education Policy (NEP), 2020” which states that continuous development of teacher's capacity is important. The NEP 2020 also mandates the completion of 50 hours of CPD every year to ensure a continuous process of professional development and improvement of teachers' professionalism. This study shows that this mandate is supported as CPD has a positive impact on pedagogical transformations, teaching effectiveness and student engagement. But a careful reading of the results shows that the 50 hours requirement may not give rise to much change in the teachers' work. The effectiveness of CPD will be highly dependent on the quality, relevance and contextual use of the CPD, rather than the time of delivery. Teachers reported an imbalance between the policy level and the practice

level in implementing CPD learning, including the workload, time pressure and lack of institutional support, in several instances. It can be seen from the study that CPD when it is actually practiced, continuous and supported by institutional practices such as mentoring, teamwork and follow-up activities can make a difference. In this way, NEP 2020 is providing a definite policy direction but to realize this, it is necessary to shift from the compliance to transformative and reflective mode. In sum, the advantages of CPD for teaching in engineering education are significant, but their extent is greatly reliant on the design, implementation and facilitation of CPD in the institutional context. The need for a balanced approach for both quality and quantity of CPD is very urgent to achieve the overall educational goals that were envisioned in NEP 2020.

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