Professional Development Practices in Teacher Education
Infusing AI: A Professional Development Practices in Teacher Education through Wenger's Communities of Practice

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ABSTRACT

Teaching is a dynamic field which requires constant learning and upskilling to ensure that the educators are well equipped and aware of the evolving classroom environment, and technologies. Teacher education requires continuous professional development practices for an effective outcome in student's learning and progress. This research paper focuses on the effectiveness of professional development programs in teacher education, emphasizes on their significance, theoretical foundations, challenges, and future directions. This study is built upon a key learning theory like Wenger's communities of practice to highlight the importance of lifelong learning among teachers. This research paper examines the current professional development programs in equipping teachers with the necessary skills to integrate AI driven learning and emerging educational technologies into their teaching practices for their future direction. This study examines various models of professional developments such as formal programs, workshops, seminars, webinars, mentoring, online courses, peer observations, Faculty DPs and PDPs with a focus on their effectiveness in enhancing teacher's instructional skills and student's outcome. Challenges such as institutional constraints, workload issues, and resistance to change are identified as barriers to effective professional development. This research paper highlights the need for sustained, research informed, and contextually relevant professional development programs that ensures the continuous growth of educators and the overall improvement of teaching and learning.

Keywords: *Professional Development, Teacher Education, Classroom, Technology, AI, Communities of Practice.*

I. INTRODUCTION

Teaching is not just a job where you learn, qualify and take up the position to teach, it requires continuous learning, and learning agility to sustain, and to infuse progress within the student. The knowledge and exposure a batch has when a teacher teaches in 2025 will not be the same when she teaches a different batch in 2030. Within these 5 years of time, students change, their exposure to technology changes, their accessibility to knowledge changes, their skills, and competent level changes. By 5 years, the teacher has to deal with an entirely different generation, with different capabilities and skills. To make the teacher community well equipped to the evolving classroom setting, there is a need for adapting to technology infused learning. To deal with the changing generations of students, there is a need for upskilling the teachers and it is achievable only through proper professional development programs. These programs are offered in different modes such as FDPs, PDPs, workshops, seminars, webinars, etc. But the real question is, do these professional development programs really coincide with the current evolution in the educational system, and student's learning? seminar papers and projects. How do teachers evaluate these kinds of work done by a These days, students are very much aware and good at using AI to create their assignments, student? How do we check the authenticity of these works? A teacher has to be well equipped and aware of the technology to check the originality of a work to have a fair evaluation due to the evolving and emerging AI technology in education. But how

do we upskill and professionally help these teachers grow? It is achievable only through relevant Professional development programs that help teachers to sustain, upskill and equip them to face the evolving educational trends and students for a better learning and outcome. This study focuses on proving that a professional development program is more effective when we incorporate Wenger's *communities of practice* while designing programs for teachers. The significance of this paper focuses on improving the quality of education in accordance with the evolving technology for a better learning, and outcome among the teachers.

Wenger's Communities of Practice (CoP) - Overview

Etienne Wenger along with Jean Lave introduced the concept of Communities of Practice in their 1991 book called *Situated Learning: Legitimate peripheral participation*. The idea of communities of practice was later developed into Wenger's solo work called *Communities of Practice: Learning, Meaning, and Identity* in 1998, he found that learning is not just an individual activity but a deeply social activity that is rooted in shared experience, and interaction. A community of practice is defined as a group of people who share their concern, a set of problems, and passion about a topic to deepen their knowledge and expertise by an ongoing interaction.

Objectives of this study:

- To ensure continuous learning among the educators to face the evolving classroom environment and education.
- To equip the educators and prepare them for AI infused teaching and learning.
- To explore the role of Wenger's CoP in supporting the effective implementation of professional development strategies.

II. LITERATURE REVIEW

Professional development programs have long been considered as a critical part in improving the teacher's teaching quality, and students' outcome. Traditional PD programs often involve short term workshops or lectures, which lack sustained engagement and practical application. Researchers have constantly emphasized on the need for an ongoing, collaborative, and contextualized PD practices that would encourage teacher-reflection, peer learning, and real world relevance for a better learning. (Wenger, 1998; Lieberman & Mace, 2010)

A model that has gained attention in recent years is Wenger's Communities of Practice (CoP). Wenger outlines that an effective learning takes place within communities when the members share a common domain, engage in regular interaction, and build a collective practice through shared experiences, and problem solving. In the context of teacher education CoP offers a framework for sustained professional learning, where teachers support each other, exchange practical insights, and co-create teaching strategies (Wenger & Snyder, 2000).

In India, the need for improving the PD programs is visible through platforms like DIKSHA, while some initiatives to support peer learning, and teacher networks were led by British Council, but still many programs still rely on passive, one-time training sessions with limited follow up or contextualization. Furthermore, global research discusses the integration of AI in education, there is limited literature exploring how AI can be meaningfully introduced in professional development programs for teachers, especially in government institutions across India.

Teachers are expected to evaluate AI generated student work, and integrate tools like ChatGpt, Grammarly, or any AI tools in their instruction, but many educators are hesitant and need training in navigating these changes in education. As the education system evolves towards an AI driven classroom environment, the professional development programs should evolve as well, not only to enhance skills but to maintain pedagogical integrity and fairness.

RESEARCH GAP

Professional development programs are widely considered as a cornerstone in equipping teachers with the evolving trends in education but most of the existing research focuses on conventional PD approaches such as short term workshops, formal training sessions, and top-down knowledge delivery. These models often lack sustainability, relevance and practical applicability in today's evolving educational environment, particularly as today's classrooms become increasingly influenced by emerging technologies like Artificial Intelligence.

In recent times, AI integration in education has gained humongous attention, most of the research surrounding AI in education focuses on student's learning outcomes, data-driven personalization, and institutional level infrastructure. Only a limited study has contributed to examine the preparedness, and struggles of teachers to integrate AI tools in their teaching practices. This has created a significant disconnect between technological advancement, and teacher preparedness.

PD initiatives such as FDPs and PDPs do exist in context but these often do not include comprehensive modules on AI literacy, ethical consideration in AI use, and AI tools in classroom application. Most PD frameworks do not consider teachers' varied comfort levels, access to resources, need for continuous peer support, particularly in government institutions, and less urban settings where digital exposure can be limited.

Despite the growing popularity of Wenger's Communities of Practice (CoP) as a framework for collaborative and experiential learning, its application within formal PD programs especially at equipping teachers to use AI remains underexplored. Current literature does not address much on how to integrate CoP models into PD programs to foster deeper engagement, sustained learning, and shared problem solving among educators in navigating evolving technological changes.

When it comes to Indian context, this research gap is more pronounced, as most PD programs, and AI initiatives are policy driven but lack grass-root level insights from the educators who are directly affected by these changes. This research aims to bridge the gap by offering a bottom-up perspective by gathering real data from teachers by assessing their needs and perceptions to propose a CoP based model that aligns with technological innovation and practical teaching.

RESEARCH QUESTIONS

1. To what extent do the current professional development programs align with the technological and pedagogical need of teachers in an AI driven educational environment?
2. What are all the challenges teachers face while adapting to AI infused learning environments, and how can professional development programs address these issues?
3. What are teachers' perceptions about the existing professional development programs in helping them deal with the AI generated students output?
4. What strategies can professional development programs implement to ensure teachers remain agile, and competent in technology infused classrooms over time?
5. How can Wenger's communities of practice be integrated while designing more effective professional development programs for teachers?

This research focuses on how professional development programs can evolve to meet the demands of AI infused education, this topic is still emerging in teacher education studies. Educators are aware of AI's role in education but there is limited research that connects AI integration with teacher training PD programs especially within the Indian context. One of the key contributions of this research paper is the integration of Wenger's Communities of Practice as a framework to design PD programs to make it more effective, and impactful. This research is advocated for ongoing, peer-based, collaborative learning models that reflect how teachers grow through sharing, reflecting, and doing things together. This theoretical lens adds a fresh perspective to current PD programs, showing how communities of educators can co-construct knowledge, and supports each other in adapting to rapid technological change. In short, this research paper stands out by bringing together technology, teacher development, and reconstructing PD programs through theory in a way that is practical, relevant and forward thinking. This study not only just critiques what is lacking, but also it suggests some solutions that are meaningful, sustainable, and teacher centered in the age of AI.

III. THEORETICAL FRAMEWORK AND RESEARCH DESIGN

This research focuses on using Wenger's Communities of Practice (CoP) to create structured professional development programs to incorporate AI in education for an effective outcome. The term Communities of practice is originated from Jean Lave and Etienne Wenger in 1991 from *Situated Learning: Legitimate peripheral participation*. Wenger's Communities of Practices can be very effective in the process of learning and practicing it practically. It focuses on three characteristics such as Domain, Community, and Practice.

The domain: It is not just a casual group or social network; it consists of members with shared interest on a particular topic or domain. Everyone in this group is committed to their interest or topic. This shared commitment among these people talks about their shared competence or knowledge in that particular area, this shared knowledge and competency separate them from the outsiders. The domain doesn't have to be formally recognized as expertise by the society for example, a youth gang may not be seen as experts by the society but within their gang they may have developed some survival skills, building trust, and maintaining their identity. They learn from each other, and value what they know. The community of practice is held together by a shared domain of interest or challenge. This domain creates a sense of belonging, shared learning, and identity even if outsiders don't consider it as formal expertise.

The Community: A community forms through interaction, and shared learning, members of a CoP don't just share the same interest or domain, they also actively interact with each other. They discuss, collaborate, exchange ideas, and help each other through these interactions and relations. They learn together, build trust and connection. A group of people who go to school together or work together doesn't form a community of practice. These people may study together in the same classroom or work together in the same office with the same designation, but unless they interact to share their knowledge, and grow together they don't form a CoP. A website or forum where people don't truly engage with each other is also not a CoP. When it comes to forming a community, physical closeness or daily work isn't required, what matters is intentional interaction and learning. Let's take two painters as an example here, they both don't meet often and work together, but whenever they meet, they critique each other's work, they share their knowledge with each other, they give suggestion to each other to improve each other, and develop new ideas together, this behavior makes them a CoP. A real community is formed when people with common passion or problems come together to help each other and learn together.

The Practice: In a community of practice, members are not just talking, they are doing stuff. It is not just about shared interest, a CoP is more than just a group of people with shared likes, and interests like loving a specific movie or books, It is beyond that. It is a group of practitioners who

actively do something, and share experience related to their work or practice. While practicing something it needs shared resources, and experience. Over time, these members build a shared repertoire by sharing their common experience with each other, sharing their stories, and the lessons they learned from it, tools, strategies, and techniques they used while facing challenges and ways to solve problems that come up regularly indicates CoP. This shared knowledge with each other is what defines their practice. A quick interesting conversation about taking care of a patient with a teacher doesn't make up a CoP because obviously a teacher is not going to practice it at a hospital, but the same conversation with a nurse or a doctor can be useful to them in practicing it, this can be called CoP. Practice can be both formal and informal. A professor creating a research article to document what they've learned can be taken as a formal practice, and a group of nurses who meet casually for lunch, and share stories and tips that would help other nurses in handling their patients can be taken as an informal practice. These people don't even realize that they are forming a community of practice. For a group to be a community of practice they must actively engage in a shared work or a profession and through ongoing interaction they build a collective knowledge base. It is not about liking the same thing; it is all about doing, sharing, and growing together as practitioners over time.

These three elements form a community of practice and it focuses on problem solving, request for information, seeks experience, reuses assets, builds arguments, coordination, discusses new ideas, identifies gaps in competence, and documents data. Community of practice is called by various names such as tech clubs, thematic groups, learning networks etc. These groups come in different forms such as small groups, large groups, online groups, face to face groups, global groups, and some are formally recognized while some are informal and not recognized. Communities of practice has long been from the start of humans on this earth. In most of the cases, people don't even realize that it is a Communities of practice, because it happens in a natural, and organic way.

The concept of communities of practice can be applied to various sectors like Education, Government, professional association, development projects, teacher training, etc. Let's focus on the concept of CoP in Education, and professional association to understand how it can be used in designing professional development practices in teacher education. Wenger emphasizes that teacher training is one of the earliest, and most effective applications of communities of practice within the education sector. Teachers are not just knowledge deliverers, but also practitioners who constantly develop skills, strategies, and insights through real classroom experiences. Traditional teacher training often focuses on one- time workshops, but CoP offers something deeper, ongoing, peer based learning grounded in real life experience.

Many teachers and schools, especially in rural areas are isolated which can be seen as a barrier to growth. CoP breaks this barrier by allowing them to interact with teachers from different places, and foster learning and growth. Just like students, teachers learn best when they actively participate instead of remaining a passive recipient. In most of the professional development programs it focuses on teaching the new techniques to the teachers, but it fails to train them practically on how to use the technique. CoP encourages teachers to be co-learners and co-creators of knowledge. Wenger believes that effective teacher training must go beyond formal instruction; it should involve sustained collaborative practice where teachers grow by engaging with peers, reflecting on real world experience, and developing a shared repertoire of knowledge that evolves over time.

IV. METHODOLOGY

This study uses a quantitative descriptive research design to analyze the current status, and effectiveness of professional development programs in training educators to incorporate AI in their teaching practices. Data was collected through a structured Google form survey, specifically

designed to analyze educators' experience, opinion, and ease in adapting to AI enhanced classroom setting. A total of 24 educators have participated in the survey. Participants were selected using purposive sampling, this survey targeted college- level teachers across various disciplines. The majority of the participants are from government colleges in India, with varying years of experiences with subject expertise. This approach helps us to understand how educators from a diverse background perceive, and adapt AI technology in their teaching. The survey instrument consists of a mix of close ended questions, aimed at gathering quantifiable data.

V. DISCUSSION

A group of 24 educators from various cities have participated in this survey. They all handle different subjects for college students, and most of these educators are from government colleges with years of experience from the collected data. By analyzing the collected data, most of these educators feel that the professional development programs need improvement and proper hands-on training to use and incorporate AI in evolving classroom settings. The age range of the participants ranges from 23 to 59 which can be seen in the chart 1.1. They are all from different Indian cities like Visakhapatnam, Chennai, Erode, Karaikudi, Tirunelveli, Tenkasi, Dharmapuri, Madurai, Tuticorin and Rasipuram as shown in the chart 1.2
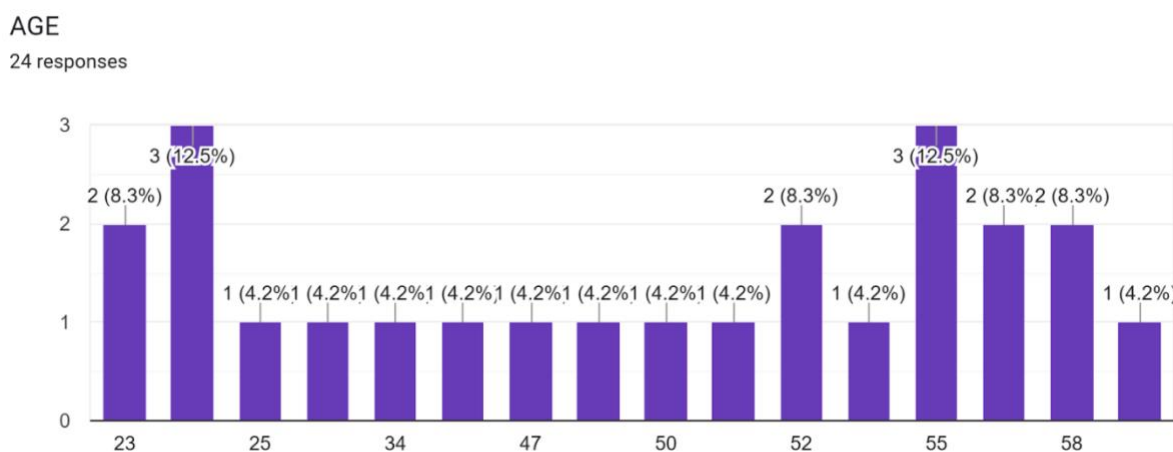

Figure1. Demographic Details - Age
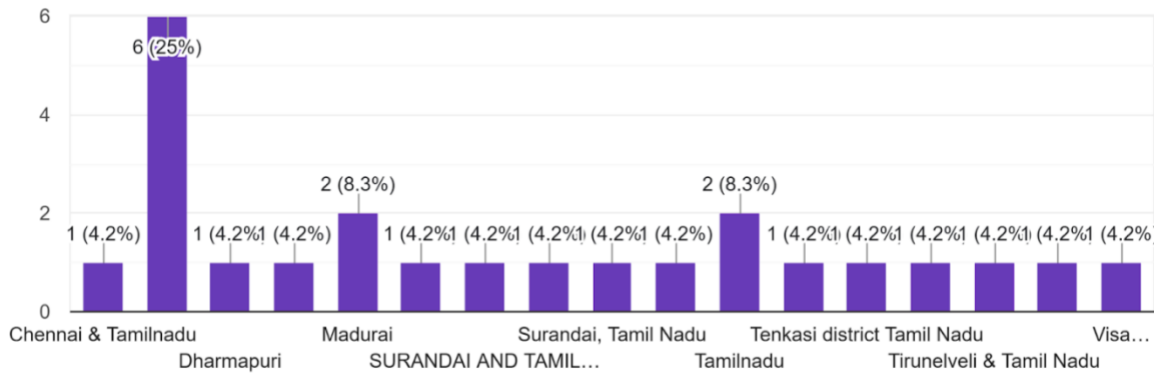
CITY AND STATE
24 responses

Figure 2. Demographic Details – City and State

The given figures, and graphs represent the current status of professional development programs in infusing AI in teaching. The root cause of solving an issue is to find where the problem lies. Based on this small survey, the majority of the educators are ready to adapt to the evolving classroom environment and infuse AI technology into their teaching and related assistance. It is evident that they have heard of many AI tools that can bring revolution in the education system, about 50% of these educators use AI for their teaching and related assistance.

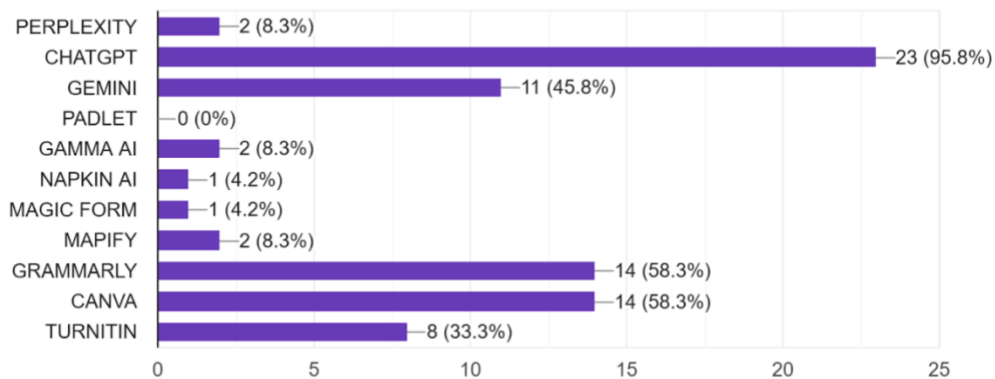SELECT THE AI SITES THAT YOU HAVE HEARD OF
24 responses

Chart 1.3

DO YOU USE AI FOR TEACHING AND RELATED ASSISTANCE?
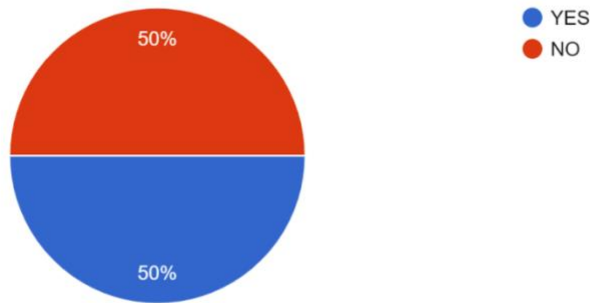24 responses

Chart 1.4

Nearly 37.5% of the educators are comfortable in using AI for education as shown in chart 1.5, and 41.7% gave a 'maybe' which can be interpreted as they have the efficiency to adapt when proper training is given to them. When we look into chart 1.6, we can see that most of the FDPs and PDPs haven't taught or incorporated AI technology with education. Nearly 66.7% of the educators have voted that the FDPs and PDPs haven't taught them on how to use AI in the evolving classroom environment or teaching. Since most of these educators are from government institutions it is a serious concern that the quality of education provided by the government needs improvement by structuring the FDPs and PDPs they organize to ensure quality education.

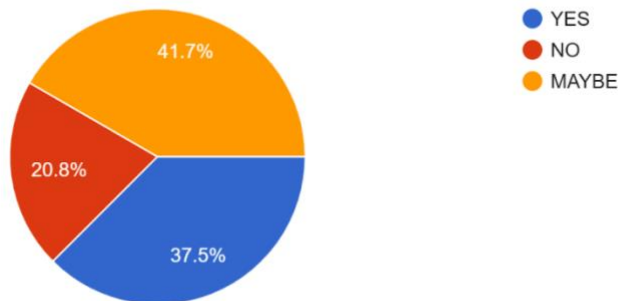ARE YOU COMFORTABLE IN USING AI TECHNOLOGY FOR EDUCATION?
24 responses

Chart 1.5

HAVE YOU ATTENDED ANY FDPs OR PDPs WHERE THEY TRAINED YOU ON HOW TO INCORPORATE AI IN TEACHING?

24 responses

- YES
- No
- SOMEWHAT
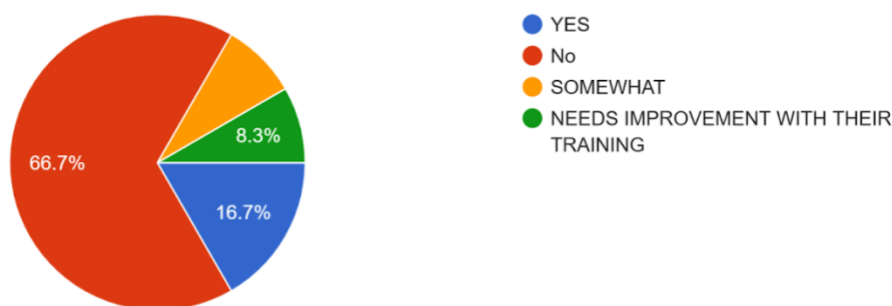- NEEDS IMPROVEMENT WITH THEIR TRAINING

66.7%
8.3%
16.7%

Chart 1.6

Most of these educators vote for hands-on training to adapt to the emerging technology. While teaching the educators, the FDPs and PDPs shouldn't focus only on giving a formal instruction. They should also incorporate Wenger's Communities of Practice while designing these programs for teachers. They should focus more on hands-on training, discussion, shared knowledge, giving their inputs and techniques to adapt to the new technology in the classroom environment. Since FDPs and PDPs already help to form a teacher community, we should focus more on the other aspects of Wenger's communities of practice to ensure effective learning among the teachers. These FDPs and PDPs shouldn't be designed as a one day workshop; instead the duration of these programs should last for atleast one week. This may help the educators to engage with each other, share their knowledge, opinion, solution and practice. This method gives them more time to practice and master how to use AI in a classroom environment. Once these programs get over, an online community or group can be created for a life-long learning as suggested in Wenger's community of practice.

- This ensures continuous learning among the educators to face the evolving classroom environment, and education.
- This will equip the educators and prepare them for AI infused teaching and learning.
- This will help them to explore the role of Wenger's CoP in supporting the effective implementation of professional development strategies.

LIMITATIONS

- This research paper and study is limited to Indian educators mainly to the cities of Tamil Nadu. So this study does not capture the perceptions of people from international platforms, and national platforms due to its smaller sample size.
- This study is limited to quantitative data collection method.
- This study is limited to general understanding, and usage of AI tools in teaching. It did not assess specific AI platforms, and training modules.
- This is limited to designing a professional development program for educators to integrate AI in their teaching, and related assistance.

VI. FINDINGS

This research paper explores the effectiveness of professional development programs like FDPs and PDPs in preparing the educators to navigate, and integrate AI into their teaching practice, and related assistance. The research aimed to analyze the current status of professional development programs in technological advancements, and evolving classroom environments, focusing on Indian educators, primarily from Tamilnadu. The data collected through a structured Google form survey revealed that the majority of the educators are willing to adapt AI enhanced teaching tools, but there was a significant gap in the training provided by the existing professional development programs. About 66.7% of respondents reported that the current FDPs and PDPs do not include adequate AI training, and 50% already use AI for their teaching without any formal training and support, this indicates a high demand for structured, hands-on, and contextually relevant professional development programs.

1. To what extent do the current professional development programs align with the technological and pedagogical need of teachers in an AI driven educational environment?

   Based on the survey conducted with 24 educators from various cities in Tamilnadu, the findings suggest that the current professional development programs do not align with the technological and pedagogical need of teachers in an AI driven educational environment. A significant 66.7% of educators reported that existing programs did not provide them with an insight or training to AI tools and strategies for integrating them into their teaching practice. This disconnection indicates that, while the educational technology is evolving, the professional programs remain outdated in most of the places and it remains insufficient in preparing the educators for the evolution.

2. What are all the challenges teachers face while adapting to AI infused learning environments, and
   how can professional development programs address these issues?

   Educators face several challenges while adapting to AI infused teaching as collected from the survey,
   - They are not exposed to AI tools and platforms.
   - They lack proper hands-on training to use AI in teaching.
   - Some of the educators are uncertain and hesitant to use AI in their teaching, and assess student's work.

   Professional development programs can address these issues by
   - Offering structured, hands-on training that goes beyond lectures and includes practical sessions.
   - Ensuring training is contextualized and relevant.
   - Creating a collaborative learning environment where teachers can share their experience and best practices.

3. What are teachers' perceptions about the existing professional development programs in helping them deal with the AI generated students output? From the data collected from the survey, teachers expressed a strong need for support in dealing with the student work created or assisted by AI. Many respondents were aware of the tools like ChatGPT, Gemini, and Grammarly being used by the students, but felt ill- equipped to use AI tools to check the authenticity and originality of their works. Only a small group of people are comfortable in using AI tools from the collected data and nearly half were unsure and some lack confidence in using AI tools. This survey implies a call for proper training and education for the educators in using AI for evaluating, teaching and related assistance.

4.   What strategies can professional development programs implement to ensure teachers remain

       agile, and competent in technology infused classrooms over time?
       To ensure ongoing adaptability and continuous learning, professional development programs should
- Incorporate Wenger's Communities of Practice model, by promoting peer-led learning and collaboration.
- It should be long term and continuous for effective learning, it shouldn't be like a one day workshop.
- It should establish online or hybrid communities for teachers to stay connected, update skills and share resources.
- It should include modules on digital ethics, academic integrity, and AI literacy.
- It should focus on hands-on training, experiential learning using real classroom scenarios.
- It should allow space for reflection and feedback, enabling teachers to evolve and adapt based on actual teaching experience.

5.   How can Wenger's communities of practice be integrated while designing more effective professional development programs for teachers? This research paper strongly supports the integration of Wenger's Communities of Practice in designing effective Professional Programs. It can be done by,
- Domain: Establish a shared focus, so participants are united by a common purpose, In this case the focus should be on AI in education.
- Community: Build a learning community where educators can engage in regular interaction, discussion, peer support, and collaboration.
- Practice: Encourage teachers to co-create resources, share classroom experience and share practical strategies where they can apply directly.

VII. CONCLUSION

This research holds significance on many levels, both practical and theoretical especially at a time when education is undergoing rapid transformation due to technological advancements like AI. One of the most important implications of this paper is that the current status of professional development programs is insufficient. Through this research and data collection, it is evident that many educators are willing to adapt to the evolving technology in education by using AI tools in their teaching but they are not being provided with proper training and support to do so. This highlights a critical disconnect between what a teacher needs and what the current professional development programs are offering.

By applying Wenger's Communities of Practice as a theoretical framework, this study emphasizes on the value of peer-based, collaborative learning in teacher training. It suggests that professional development programs need to move beyond traditional lecture based models and instead, it should move towards creating ongoing interactive communities where teachers can learn from real world experience, exchange knowledge, and grow together. This shift and coverage has the potential to create more resilient, confident and technically equipped educators for the evolving classroom environment. The findings of this study also have implications on educational policy and institutional planning particularly in government run colleges of Tamilnadu, where most of the teachers from the survey participated. It is clear that investment in long term and meaningful professional development programs with an emphasis on AI literacy and hands-on training is not just beneficial but are immediately in need for effective learning and teaching. This research paper contributes to the field of teacher education through intentional design for professional development programs which was built upon a theoretical foundation like Wenger's Communities

of Practice. This will lead to effective and lasting change in teaching practice for the evolving educational environment in technology.

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