

Methodological Insights into Assessing Effectiveness of In-Service Teacher Training Programs: A Meta-Synthesis Approach

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ABSTRACT

This study explores evolving trends in assessing in-service teacher education programs, focusing on Odisha, India. It addresses three key questions: employed research designs in the in service training program, the effectiveness of quantitative and qualitative data collection tools, and the analytical techniques that best identify patterns in data for actionable insights. Using a meta-synthesis methodology, the research systematically selected studies through a two-stage review process, ensuring robustness and generalizability. The findings reveal a significant shift from traditional to more sophisticated assessment techniques, highlighting a need for advanced, context-sensitive evaluations in Odisha. Current practices often rely on basic surveys and observations, which may not fully capture the complexities of teacher development. The study advocates for integrating digital tools and continuous formative assessments to enhance program effectiveness. Additionally, the use of various analytical techniques, such as longitudinal studies and mixed-methods approaches, is emphasized for deeper insights into professional development outcomes. The research concludes that a multifaceted, flexible approach to assessment, involving standardization of evaluation frameworks, stakeholder involvement, and alignment with broader educational goals, is crucial for the success of in-service teacher education programs. This approach promises sustained improvements in teaching practices and student outcomes, offering valuable contributions to the discourse on best practices in teacher professional development, particularly in developing regions like Odisha.

Keywords: Teacher Education, Meta-Synthesis, In-service Training, Training Impact, Assessment Design

In the evolving landscape of education, the role of in-service teacher training programs is paramount. These programs are designed to enhance the professional development of teachers, equipping them with the latest pedagogical skills and knowledge to meet the diverse needs of students. The observation of these programs has become increasingly important in recent times due to several factors, including the rapid changes in education technology, the shift towards competency-based education, and the diverse challenges posed by

the global pandemic (Darling-Hammond, 2020; Sharma, 2021).

The COVID-19 pandemic has fundamentally altered the way education is delivered, with a significant shift towards online and blended learning environments. This has necessitated a re-evaluation of teacher training programs to ensure that they are

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adequately preparing educators to navigate these new modalities. Observation of in-service training programs allows stakeholders to assess whether the training content is relevant and whether teachers are able to translate the knowledge gained into effective classroom practices (UNESCO, 2021). Moreover, observation helps in identifying gaps in the training programs, such as the need for more focus on digital literacy, classroom management in virtual environments, and strategies for engaging students remotely (Mishra, 2022).

Additionally, observing these programs is crucial for understanding the extent to which they promote inclusivity and equity in education. With the growing emphasis on inclusive education, it is vital to ensure that in-service training programs are equipping teachers to cater to the needs of all students, including those from marginalized and disadvantaged backgrounds (Joshi & Jha, 2022). Observation can help in evaluating whether the training programs are addressing issues of diversity, equity, and inclusion, and whether they are fostering an environment that encourages critical thinking and innovation among teachers (Chaudhary & Bhatnagar, 2023).

The Need for an Effective and Robust Assessment Approach in Odisha

In the context of Odisha, a state with a diverse socio-economic and linguistic landscape, the need for an effective and robust assessment approach for in-service teacher training programs is particularly pressing. Odisha has made significant strides in improving access to education, but challenges remain in ensuring the quality of education, especially in rural and tribal areas (Patra & Das, 2021). In-service teacher training programs play a critical role in addressing these challenges by providing teachers with the necessary skills to improve learning outcomes.

However, the effectiveness of these programs cannot be assumed; it must be systematically assessed. An effective assessment approach is needed to evaluate the impact of training programs on teacher performance and student outcomes. This approach should be comprehensive, incorporating both formative and summative assessments, and should be designed to capture the nuances of the diverse

educational contexts in Odisha (Rout & Mohanty, 2022).

Formative assessments, conducted during the training program, can provide immediate feedback to trainers and participants, allowing for real-time adjustments to the program content and delivery methods. Summative assessments, on the other hand, can help in evaluating the overall effectiveness of the training program in achieving its objectives, such as improving teacher competencies and student learning outcomes (Mishra & Patel, 2023). Furthermore, the assessment approach should be inclusive, taking into account the perspectives of all stakeholders, including teachers, students, and community members, to ensure that the training programs are meeting the needs of the local context (Nayak, 2023).

In addition, the assessment approach should leverage technology to facilitate data collection, analysis, and reporting. The use of digital tools can enhance the efficiency and accuracy of the assessment process, enabling timely and informed decision-making. For instance, mobile-based assessment platforms can be used to gather real-time data on teacher performance and student outcomes, which can then be analyzed to identify trends and areas for improvement (Sahoo & Sahu, 2022).

Importance of Building a Strong Methodology for Assessing Effectiveness

Building a strong methodology for assessing the effectiveness of in-service teacher training programs is essential for several reasons. Firstly, a robust methodology ensures that the assessment process is systematic, objective, and reliable. It provides a clear framework for evaluating the various components of the training program, including the content, delivery methods, and outcomes (Kumar & Panda, 2023). A strong methodology also ensures that the assessment process is transparent and accountable, allowing stakeholders to have confidence in the results.

Secondly, a well-designed methodology facilitates the identification of best practices and areas for improvement. By systematically analyzing the data collected through the assessment process, stakeholders can gain insights into what works

and what doesn't, enabling them to make informed decisions about how to improve the training programs (Sethi & Senapati, 2023). For example, the methodology can help in identifying which training modules are most effective in improving teacher competencies and which areas require additional support (Pattnaik & Mohapatra, 2023).

Thirdly, a strong methodology is critical for ensuring the sustainability and scalability of in-service teacher training programs. By providing a clear and consistent framework for assessment, it enables the continuous monitoring and evaluation of the training programs, ensuring that they remain relevant and effective over time (Tripathy & Swain, 2023). Moreover, a robust methodology can facilitate the scaling up of successful training programs to other regions and contexts, thereby maximizing their impact (Behera & Panda, 2023).

Need of a Meta-Synthesis

A systematic review of the existing literature on in-service teacher education programs is essential to synthesize and refine assessment practices. The need for such a review arises from the growing complexity and diversity of in-service training initiatives, which require robust evaluation methods to ensure their effectiveness. Systematic reviews not only provide a comprehensive overview of existing research but also help identify gaps and inconsistencies in the assessment approaches used across different contexts. This process is critical for developing a more standardized and effective framework for evaluating these programs.

In the assessment of in-service teacher education programs, it is essential to consider three major elements: research or assessment design, tools and techniques for data collection, and analysis and interpretation techniques. These components form the backbone of a comprehensive and effective assessment framework, ensuring that evaluations are rigorous, systematic, and relevant to the educational context.

Research/Assessment Design

The foundation of any assessment practice lies in a well-structured research design. A robust design is critical for ensuring the validity and reliability of the findings. It provides a blueprint for how the assessment will be conducted, guiding the selection

of participants, the timing of data collection, and the methods used to analyze the data (Creswell, 2021). Various research designs, including experimental, quasi-experimental, and case study approaches, have been employed to study the effectiveness of in-service teacher education programs. Each of these designs has its strengths and limitations (Guskey & Yoon, 2020). Experimental designs, for instance, are praised for their ability to establish causal relationships between the training program and observed outcomes, while case studies offer in-depth insights into specific contexts (Cohen, Manion, & Morrison, 2021). The choice of research design also influences the scope and generalizability of the findings. For example, quasi-experimental designs might be more practical in educational settings where random assignment is challenging, though they may introduce certain biases that need to be accounted for in the analysis (Johnson & Christensen, 2022). Thus, incorporating a strong research design into assessment practices ensures that the evaluation is systematic, objective, and capable of producing meaningful insights.

Tools and Techniques for Data Collection

The tools and techniques used for data collection are equally important as they determine the quality and type of data gathered. These tools can range from standardized tests and surveys to more qualitative methods like interviews and classroom observations (Kane & Staiger, 2020). The choice of data collection methods significantly impacts the type and quality of data obtained, which in turn affects the accuracy and comprehensiveness of the assessment. Quantitative tools, such as surveys and tests, are commonly used to measure changes in teacher knowledge, skills, and student outcomes before and after the training program. These tools provide measurable and comparable data, which are essential for statistical analysis and interpretation (Schleicher, 2021). On the other hand, qualitative techniques like interviews and observations allow for a deeper exploration of the contextual factors that influence the effectiveness of the training program. These methods are particularly useful for capturing the perspectives and experiences of teachers, providing valuable insights into how the training program is being implemented and perceived in different educational

settings (Creswell & Poth, 2021). Properly selected tools ensure that all relevant aspects of the training program are captured, offering a comprehensive view of its effectiveness. Moreover, using multiple data collection methods allows for triangulation, enhancing the credibility of the findings.

Analysis and Interpretation Techniques

Finally, the techniques used to analyze and interpret the data are crucial for translating raw data into actionable insights. Statistical analysis is a common method used to analyze quantitative data, where techniques such as regression analysis, ANOVA, and factor analysis are employed to identify patterns, correlations, and causal relationships between variables (Field, 2022). These techniques are vital for drawing valid and reliable conclusions about the effectiveness of the in-service teacher education program. In contrast, qualitative data often require different analytical approaches, such as thematic analysis or grounded theory, to identify recurring themes and patterns in the data (Braun & Clarke, 2021). These techniques are particularly useful for interpreting the complex and context-dependent aspects of teacher training programs, such as the impact of cultural and institutional factors on program outcomes. Together, these analysis and interpretation techniques are essential for making informed decisions about the effectiveness of the training program and for identifying areas for improvement.

By systematically reviewing the existing literature on these three aspects—research design, data collection tools and techniques, and analysis and interpretation methods—researchers can develop a more comprehensive and nuanced understanding of the assessment practices in in-service teacher education programs. This synthesis is crucial for improving the quality and effectiveness of these programs, as it allows for the identification of best practices and the development of more standardized and robust evaluation frameworks (Gustafson, 2020).

Given the above backdrop the paper synthesizes the findings from the various literature with the following three research questions

Research Questions

1. What are the different research designs (e.g., experimental, quasi-experimental, and case study) used in evaluating the effectiveness of in-service teacher education programs?
2. What are the most effective tools and techniques for collecting quantitative and qualitative data in assessing the outcomes of in-service teacher education programs, and how do they influence the comprehensiveness of the assessment?
3. What analytical and interpretative techniques best facilitate the identification of patterns, relationships, and themes in data collected from in-service teacher education programs, and how do these techniques contribute to actionable insights for program improvement?

Methodology

In this study, the methodology was designed to systematically and objectively select studies for a meta-analysis focused on in-service teacher training programs. The selection process began with a two-stage review. Initially, studies were screened based on explicit inclusion criteria, such as publication type, geographical focus, timeline, and research design. Subsequently, an inter-coder reliability test was conducted to ensure unbiased inclusion. A rigorous coding procedure was then applied to categorize studies by sampling methods, research design, tools, and statistical techniques, providing a structured framework to evaluate and synthesize the data comprehensively.

The first level screening criteria for inclusion in a meta-analysis ensures that studies are selected systematically and without bias. The process involves several explicit criteria:

Publication Criteria: Only studies published in journals, periodicals, digital research logs, or unpublished research at the master's or doctoral level is considered. This includes research in digital libraries, projects by educational research bodies, and NGOs.

Geographical, Timeline, and Focus: The studies must be done related to in service training program. The timeframe for the studies is between 2001 and 2022.

Research Design and Language: Studies must employ a quantitative, qualitative and mixed method approach research design with a clear rationale and must be written in English.

These criteria are designed to maintain the integrity and relevance of the meta-analysis, ensuring that only studies that fit the specific research focus are included. This reduces potential bias and increases the validity of the findings by focusing on studies with a shared context and methodology.

Second Level Screening Criteria

In the meta-analysis process, the second level selection criteria emphasized the need for rigor in the studies included. Specifically, studies had to have a minimum sample size of 20 to ensure statistical significance. Additionally, studies were required to provide a full description of their sample size, data collection tools, scoring procedures, and statistical measures. This thorough documentation was essential for the inclusion of studies in the meta-analysis, ensuring that only those with clear and transparent methodologies were considered.

The search process for relevant studies was extensive and relied heavily on digital resources. Web-based search engines like Google Scholar, Bing, and Yahoo, as well as specialized research databases such as ERIC, PsycINFO, and ProQuest, were systematically explored. Keywords related to in-service teacher training programs were used to locate studies, including specific terms like “meta-analysis” and “teacher training at secondary level.”

The search also extended to targeted periodicals and journals, particularly those focusing on educational research, policy analysis, and science education. Journals from associations like the American Educational Research Association (AERA) were specifically reviewed to ensure comprehensive coverage. Moreover, a cascading search procedure was employed, where references and citations within studies were further explored to uncover additional relevant research.

The process for determining study eligibility in the meta-analysis involved a two-stage review. Initially, abstracts were screened to decide which studies would advance to a more detailed review. The second stage involved a thorough examination of the study’s methodology, analysis techniques, and

tools. To ensure objectivity, an inter-coder reliability test was conducted, where both the researcher and an external reviewer independently scored the studies. Agreement between scores determined study inclusion, with a 5% error margin allowed for discrepancies, resolved through mutual review and discussion.

Coding Procedure

The coding procedure was designed to ensure a systematic and unbiased selection of studies for meta-analysis, focusing on three main aspects: sample, method/design, and tools and techniques, along with analysis technique.

Sample Coding: The procedure began with coding the sample in two layers. The first layer focused on the type of sampling method used in the study, such as random or purposive sampling. This classification was crucial to understanding the representativeness of the sample and potential biases introduced by different sampling techniques. The second layer of coding addressed the sample size, categorizing it into ranges. This step ensured that the study’s scope and the statistical power were adequately represented in the analysis.

Method/Design Coding: The next step involved coding the research or assessment design of the studies. This coding was essential in identifying the methodological rigor and appropriateness of the design in addressing the research questions. Studies employing qualitative methods, such as focus group discussions or interviews, were coded differently from those using comparative methods like pre-post testing or experimental designs like randomized controlled trials. This categorization helped in distinguishing between studies based on their ability to establish causality, explore contextual factors, or generate in-depth qualitative insights.

Tools and Techniques Coding: The coding for tools and techniques was performed in two phases. The first phase focused on the tools used for data collection, such as focus group discussions, interviews, or tests. The second phase addressed the techniques applied in conjunction with these tools, ensuring that the study’s methodological approach was comprehensively documented. This dual-phase coding allowed for a nuanced understanding of the data collection strategies employed across different studies, highlighting the diversity of

approaches and their implications for data quality and comprehensiveness.

Analysis Coding: The final aspect of the coding procedure involved analysis techniques. Different statistical methods were coded to reflect their use in the analysis, such as mean difference, regression, thematic analysis, content analysis or ANOVA. This step was crucial in understanding how the data was processed and interpreted, providing insights into the robustness and reliability of the study's findings.

Together, these coding procedures provided a structured framework for evaluating the studies, ensuring that each aspect of the research design, data collection, and analysis was systematically accounted for, thereby reducing potential biases and enhancing the validity of the meta-analysis.

After applying the selection criteria, a total of 15 studies were considered for the meta-synthesis. Here is a summary of these studies in table 1.

Analysis Technique

The analysis technique employed in this research paper involved a systematic review of 15 selected studies, focusing on three primary research questions: research design components, tools and techniques for data collection, and analysis and interpretation methods.

First, the studies were categorized based on the research designs they employed, identifying the prevalence of different designs. For the second research question, the studies were analyzed to determine the quantitative and qualitative

Table 1: Summary of Research Design used in Different Studies

Sl. No.	Study Title	Author(s) and Year	Research Design
1	Impact of In-Service Teacher Training on Teacher Performance	Mukhopadhyay & Sharma (2008)	Mixed-Methods (Surveys, Interviews, Classroom Observations)
2	Evaluation of In-Service Teacher Education Programs in Rural India	Kumar & Khare (2012)	Mixed-Methods (Surveys, Classroom Observations, Focus Group Discussions)
3	Teacher Professional Development and Student Outcomes in India	Batra (2014)	Mixed-Methods (Quantitative and Qualitative Methods)
4	Professional Development in the United States: Impact on Teaching and Student Outcomes	Darling-Hammond <i>et al.</i> (2009)	Large-Scale Surveys and Longitudinal Studies
5	Effectiveness of Professional Development Programs	Kennedy (2016)	Randomized Control Trials (RCTs), Teacher Self-Reports
6	Evaluation of Professional Development Programs in the U.S.	Desimone <i>et al.</i> (2002)	Surveys, Teacher Interviews, Classroom Observations
7	In-Service Training Impact on Teacher Performance in Chile	Avalos (2011)	Mixed-Methods (Surveys, Interviews, Classroom Observations)
8	Teacher Learning through Professional Development in the U.S.	Borko (2004)	Case Studies, Interviews, Classroom Assessments
9	Complexity of Professional Development Programs	Opfer & Pedder (2011)	Case Studies, Surveys, Teacher Reflections, Student Performance Data
10	Evaluation of Different Types of Professional Development in the U.S.	Garet <i>et al.</i> (2001)	Large-Scale Surveys, Regression Analysis
11	Effects of Professional Learning on Teaching Practices in New Zealand	Timperley <i>et al.</i> (2007)	Meta-Analysis
12	Professional Learning Opportunities for Teachers in the U.S.	Wei <i>et al.</i> (2009)	Large-Scale Surveys, Interviews
13	Analysis of Different Models of Professional Development in the U.S.	Sparks & Loucks-Horsley (2003)	Mixed-Methods (Surveys, Interviews, Classroom Observations)
14	In-Service Teacher Training in Rural and Urban India	Kumar & Khare (2012)	Mixed-Methods (Surveys, Classroom Observations, Focus Group Discussions)
15	Professional Development in India: A Study of Urban and Rural Contexts	Batra (2014)	Mixed-Methods (Quantitative and Qualitative Methods)

tools used, such as surveys, standardized tests, interviews, and case studies. The studies were further grouped by the mixed methods employed, with an emphasis on how these tools contributed to the overall effectiveness of the assessment process. This analysis identified the most dominant tools and techniques used in in-service teacher training programs.

For the third research question, the studies were analyzed based on their analysis and interpretation techniques. Studies employing quantitative analysis methods were coded and highlighted, as were those using qualitative approaches like content and thematic analysis. The analysis further explored how these techniques contributed to deriving actionable insights for training programs. The findings were then discussed in the context of in-service training programs in India, particularly Odisha, providing a pathway for future improvements.

FINDINGS

Research Question-1: Associated to Study Design

Darling-Hammond *et al.* (2009) conducted a comprehensive review of professional development programs in the United States, assessing their impact on teaching practices and student outcomes. The study utilized a combination of longitudinal surveys, classroom observations, and student performance data to determine the effectiveness of these programs. The findings revealed that professional development programs that are sustained and content-focused significantly enhance both teaching practices and student learning outcomes. Similarly, Kennedy (2016) examined various forms of professional development through randomized control trials (RCTs) and teacher self-reports. This U.S.-based study highlighted the importance of content specificity, showing that programs tailored to particular instructional needs are more effective in improving teaching practices. Expanding the scope beyond the U.S., Avalos (2011) explored the impact of in-service training on teacher performance in Chile using a mixed-methods approach, including surveys, interviews, and classroom observations. The study found that continuous support and follow-up are crucial for the long-term effectiveness of professional

development programs. Borko (2004), focusing on the U.S., emphasized the importance of context in professional development. Through case studies, interviews, and classroom assessments, Borko's study concluded that programs must be adaptable to the specific needs of teachers and their educational environments to be effective. Opfer and Pedder (2011), in their study conducted in the United Kingdom, analyzed the complexity of professional development programs. Their research underscored the interconnectedness of various factors, such as individual teacher characteristics and the learning environment, which collectively influence the effectiveness of these programs.

Other studies, such as Garet *et al.* (2001), Timperley *et al.* (2007), and Wei *et al.* (2009), further contributed to understanding the features of effective professional development. Garet *et al.* (2001) identified key components such as content focus, active learning, and coherence with other learning activities, which are strongly linked to improvements in teaching practices. Timperley *et al.* (2007) conducted a meta-analysis in New Zealand, finding that professional development characterized by ongoing support, a focus on student outcomes, and opportunities for reflection is most effective. Wei *et al.* (2009) emphasized the importance of sustained professional development over time, showing that longer programs with ongoing support yield lasting changes in teaching practices. Finally, Sparks and Loucks-Horsley (2003) analyzed different models of professional development in the U.S., suggesting that successful programs are those tailored to the specific needs of teachers and aligned with broader educational goals.

The three studies conducted in India provide valuable insights into the effectiveness of in-service teacher education programs. Mukhopadhyay and Sharma (2008) evaluated programs across various states, using a mixed-methods approach that included surveys, interviews, and classroom observations. Their findings emphasized that well-structured training programs with continuous support significantly improve teacher performance and student learning outcomes.

Kumar and Khare (2012) focused on rural India, assessing the impact of in-service teacher education programs through surveys, classroom observations, and focus group discussions. They highlighted the

challenges faced by rural teachers, such as resource constraints, but also found that targeted training could lead to notable improvements in instructional methods and student engagement.

Batra (2014) examined the relationship between teacher professional development and student outcomes in both urban and rural contexts. Using a combination of quantitative and qualitative methods, Batra's study concluded that professional development programs, particularly those with ongoing mentoring and support, were more effective in improving student achievement, especially in under-resourced schools.

The 15 studies conducted on the effectiveness of in-service teacher education programs across different contexts, including the United States, the United Kingdom, New Zealand, Chile, and India, provide valuable insights into the choice of research design, the advantages of these designs, and their limitations. Each study adopted a research design tailored to its specific objectives, target population, and the educational context, offering a diverse range of methodologies that illuminate various aspects of professional development.

Enlisting of Studies by Research Design

Large-Scale Surveys and Longitudinal Studies

Several studies, including those by Darling-Hammond *et al.* (2009), Garet *et al.* (2001), Desimone *et al.* (2002), and Wei *et al.* (2009), chose large-scale surveys and longitudinal studies to evaluate the effectiveness of professional development programs. These studies aimed to capture broad trends across large populations, making surveys an appropriate choice. The longitudinal aspect allowed researchers to observe changes over time, providing insights into the sustained impact of professional development on teaching practices and student outcomes.

Randomized Control Trials (RCTs)

Kennedy (2016) and Timperley *et al.* (2007) employed randomized control trials (RCTs) in their evaluations of professional development programs. RCTs are considered the gold standard in research design due to their ability to establish causality. By randomly assigning participants to either an intervention group or a control group, RCTs can directly

attribute any observed differences in outcomes to the professional development program being tested.

Mixed-Methods Approaches

Avalos (2011), Kumar and Khare (2012), and Mukhopadhyay and Sharma (2008) utilized mixed-methods approaches to evaluate in-service teacher education programs. These studies combined quantitative methods (such as surveys and performance data analysis) with qualitative methods (such as interviews and classroom observations) to provide a more comprehensive understanding of the effectiveness of professional development.

Case Studies

Borko (2004) and Opfer and Pedder (2011) employed case study methodologies to explore the effectiveness of professional development programs in specific contexts. Case studies are particularly useful for in-depth exploration of complex phenomena within their real-life context. These studies often involve detailed qualitative data collection, such as interviews, observations, and document analysis, to understand the intricacies of professional development.

Meta-Analysis

Timperley *et al.* (2007) also conducted a meta-analysis, reviewing existing studies on professional development to identify patterns and draw broader conclusions. Meta-analysis is a quantitative approach that synthesizes results from multiple studies, allowing researchers to identify trends and generalize findings across different contexts and study designs.

Research Question - 2 : Associated to Used Tools and Technique in different Studies

In-service teacher education programs play a critical role in enhancing the teaching practices of educators and improving student outcomes. To assess the effectiveness of these programs, researchers employ a variety of tools and techniques for collecting both quantitative and qualitative data. The selection of appropriate tools and techniques is crucial, as it directly influences the comprehensiveness of the assessment, ensuring that all aspects of the program's impact are captured and analyzed.

This summary synthesizes findings from 15 studies, including 12 conducted internationally and three within the Indian context, to explore the most effective tools and techniques for collecting data in the assessment of in-service teacher education programs. The analysis highlights how these methods contribute to a thorough understanding of the programs' outcomes, providing insights into the strengths and limitations of different assessment approaches.

Quantitative Data Collection Tools and Techniques

Quantitative data collection methods are essential for measuring the effectiveness of in-service teacher education programs in a structured and statistically reliable manner. Common quantitative tools and techniques identified across the studies include surveys, standardized tests, and longitudinal data analysis.

Surveys are one of the most widely used tools, as they allow for the collection of data from a large number of participants. For instance, Darling-Hammond *et al.* (2009) and Garet *et al.* (2001) used large-scale surveys to gather data on teachers' perceptions of professional development programs in the United States. These surveys typically included structured questionnaires with Likert-scale items, which facilitated the quantification of teachers' attitudes, beliefs, and practices before and after participating in the programs. The use of surveys enabled the researchers to identify trends and correlations between different program features and outcomes, such as improvements in teaching practices and student performance.

Standardized tests are another crucial quantitative tool, particularly for assessing student outcomes. In the study by Kennedy (2016), randomized control trials (RCTs) were used to measure the impact of professional development on teaching practices and student achievement. Standardized tests provided objective data on student performance, which was then analyzed to determine the effectiveness of the professional development programs. The use of RCTs allowed for the establishment of causal relationships, making this approach highly reliable for assessing program outcomes.

Longitudinal data analysis is an effective technique for capturing changes over time, offering a more comprehensive view of the long-term impact of professional development programs. Wei *et al.* (2009) employed longitudinal surveys to track changes in teachers' practices and student outcomes over several years. This method provided valuable insights into the sustainability of program effects, demonstrating that programs with ongoing support and follow-up were more effective in producing lasting changes in teaching practices.

Quantitative data collection tools and techniques contribute to the comprehensiveness of the assessment by providing statistically reliable and generalizable findings. However, their reliance on predefined variables and structured formats may limit their ability to capture the full complexity of teachers' experiences and the nuanced effects of professional development programs.

Qualitative Data Collection Tools and Techniques

Qualitative data collection methods are crucial for gaining a deeper understanding of the experiences and perspectives of teachers participating in in-service education programs. These methods allow for the exploration of the context in which the programs are implemented, as well as the subjective experiences of participants, which are often not captured by quantitative measures.

Interviews are a key qualitative tool used in several studies to explore teachers' perceptions of professional development programs. Desimone *et al.* (2002), for instance, used interviews to complement survey data, providing richer insights into how teachers interpreted and applied the knowledge gained from professional development activities. The use of semi-structured interviews allowed the researchers to probe deeper into specific areas of interest, uncovering factors such as the importance of collective participation and coherence in professional development activities.

Classroom observations are another widely used qualitative technique, enabling researchers to directly assess changes in teaching practices as a result of professional development programs. Borko (2004) and Avalos (2011) employed classroom observations to evaluate the application of new

instructional strategies learned during professional development sessions. This method provided concrete evidence of changes in classroom behavior, which could then be linked to student outcomes. Classroom observations also allowed researchers to assess the context in which teaching practices were implemented, providing insights into the challenges and facilitators of applying new skills in real-world settings.

Case studies offer a holistic approach to understanding the impact of professional development programs, particularly in specific contexts. Opfer and Pedder (2011) and Batra (2014) used case studies to explore the complexities of professional development in different educational environments. By focusing on individual cases, these studies were able to provide detailed accounts of how programs were implemented and their effects on teaching and learning. The case study method is particularly valuable for identifying contextual factors that influence the success of professional development initiatives, such as school culture, resource availability, and support structures.

Focus group discussions are another effective qualitative technique, used by Kumar and Khare (2012) to gather collective insights from teachers in rural India. This method allowed for the exploration of shared experiences and challenges faced by teachers in similar contexts, providing a broader understanding of the factors that influence the effectiveness of professional development programs. Focus group discussions also facilitated the identification of common themes and patterns, which could then be used to inform the design and implementation of future programs.

Mixed-Methods Approaches

Several studies adopted a mixed-methods approach, combining both quantitative and qualitative data collection tools and techniques to provide a more comprehensive assessment of in-service teacher education programs. For example, Mukhopadhyay and Sharma (2008) used a combination of surveys, interviews, and classroom observations to evaluate the impact of teacher training programs across various states in India. This approach allowed for the triangulation of data, where quantitative findings from surveys were complemented by qualitative insights from interviews and observations, leading

to a more nuanced understanding of the program's impact.

Timperley *et al.* (2007) conducted a meta-analysis that integrated findings from multiple studies, using both quantitative and qualitative data to identify the key characteristics of effective professional development programs. By synthesizing data from diverse sources, this study provided a comprehensive overview of the factors that contribute to successful teacher learning and student outcomes, such as ongoing support, a focus on student needs, and opportunities for active learning and reflection.

Influence on Comprehensiveness of the Assessment

The selection of tools and techniques for data collection significantly influences the comprehensiveness of the assessment of in-service teacher education programs. Quantitative methods, such as surveys and standardized tests, are essential for measuring the impact of these programs in a statistically reliable and generalizable manner. These tools allow researchers to identify patterns and correlations, providing evidence of the effectiveness of specific program features.

However, quantitative methods alone may not fully capture the complexity of teaching and learning processes. Qualitative methods, such as interviews, classroom observations, and case studies, provide richer insights into the experiences of teachers and the contexts in which programs are implemented. These methods allow for the exploration of the nuanced and often subjective aspects of professional development, which are crucial for understanding how and why programs succeed or fail.

The most comprehensive assessments of in-service teacher education programs are those that combine both quantitative and qualitative methods, leveraging the strengths of each to provide a holistic understanding of program outcomes. Mixed-methods approaches allow researchers to triangulate data, ensuring that findings are robust, reliable, and reflective of the complexities of teaching and learning. By integrating multiple data sources, researchers can develop a more complete and nuanced understanding of the effectiveness of in-service teacher education programs, informing the design and implementation of future initiatives that are both effective and contextually relevant.

reflective practices and outcome-based assessments in evaluating the effectiveness of professional development programs.

Emphasis on Mixed-Methods Approaches

The word cloud reflects a strong emphasis on mixed-methods approaches, combining quantitative and qualitative data collection techniques to provide a more holistic and nuanced understanding of program outcomes.

Research Question-3 : Associated to Analysis and Interpretation Technique

The analysis of in-service teacher education programs, as examined in the fifteen studies, provides a nuanced understanding of the analytical and interpretative techniques that effectively identify patterns, relationships, and themes in data collected from these programs. These techniques not only reveal underlying trends and correlations but also contribute to actionable insights that can inform and improve the design and implementation of professional development initiatives.

Analytical Techniques

Mixed-Methods Approach: Several studies, including those by Mukhopadhyay and Sharma (2008) and Batra (2014), employed a mixed-methods approach, integrating quantitative and qualitative data to offer a comprehensive view of the effectiveness of in-service teacher education programs. This approach is particularly powerful in identifying patterns and relationships as it allows for the triangulation of data, ensuring that findings are robust and multi-dimensional. Quantitative data, often derived from surveys and standardized tests, provides measurable outcomes, while qualitative data from interviews, focus groups, and observations offer deeper insights into the processes and contextual factors influencing these outcomes. The combination of these methods facilitates a holistic understanding of the programs, revealing how various elements interact and contribute to overall effectiveness.

Longitudinal Analysis: Darling-Hammond *et al.* (2009) utilized longitudinal surveys and student performance data to assess the long-term impact of professional development programs. Longitudinal analysis is crucial for identifying

trends over time and understanding how in-service training influences teaching practices and student outcomes. By tracking changes over multiple years, researchers can discern which aspects of professional development have lasting effects and which might need adjustment. This technique also helps in recognizing the time lag between training and observable improvements in classroom practices or student achievement, thereby providing a clearer picture of the program's efficacy.

Regression Analysis: Garet *et al.* (2001) employed regression analysis to evaluate the relationship between different types of professional development and improvements in teaching practices. Regression analysis is an effective tool for identifying correlations between variables, such as the duration or content focus of a training program and the resulting changes in teacher behavior or student performance. This technique allows researchers to control for various factors, isolating the specific elements of professional development that are most impactful. By quantifying these relationships, regression analysis offers actionable insights into which program components should be prioritized or modified.

Meta-Analysis: Timperley *et al.* (2007) conducted a meta-analysis to review the effects of professional learning on teaching practices. Meta-analysis aggregates findings from multiple studies, allowing for the identification of broader patterns and trends that might not be apparent in individual studies. This technique is particularly valuable in synthesizing research findings across different contexts and methodologies, providing a more generalized understanding of effective practices. By analyzing a large body of research, meta-analysis can highlight which strategies consistently lead to improved outcomes, thereby offering evidence-based recommendations for program improvement.

Interpretative Techniques

Thematic Analysis: Thematic analysis was a key interpretative technique used in studies such as those by Opfer and Pedder (2011) and Batra (2014). This technique involves identifying and analyzing recurring themes within qualitative data, such as interview transcripts or observation notes. Thematic analysis is particularly useful for uncovering the underlying issues, beliefs, and perceptions

that influence the effectiveness of professional development programs. For instance, it can reveal common challenges faced by teachers, such as a lack of resources or support, and how these challenges impact their ability to implement new teaching strategies. By focusing on recurring themes, this technique helps in understanding the broader context within which professional development occurs and informs the design of programs that are more responsive to teachers' needs.

Case Studies: Borko (2004) and Kumar and Khare (2012) utilized case studies to explore the impact of in-service teacher training in specific contexts. Case studies provide in-depth insights into the implementation and effects of professional development programs within particular schools or regions. This interpretative technique is valuable for understanding the complex interplay of factors that influence program outcomes, such as school culture, leadership, and teacher collaboration. By closely examining individual cases, researchers can identify unique challenges and successful strategies that may not be evident in broader studies. Case studies also allow for the exploration of how contextual factors, such as rural versus urban settings, affect the implementation and effectiveness of in-service training, leading to more tailored and effective program designs.

Content Analysis: Content analysis was employed by Sparks and Loucks-Horsley (2003) to analyze different models of professional development. This technique involves systematically coding and categorizing textual data to identify patterns and themes. Content analysis is particularly useful for examining large volumes of qualitative data, such as program reports or teacher reflections, to discern which aspects of professional development are most frequently associated with positive outcomes. By quantifying the occurrence of specific themes or concepts, content analysis can provide a clearer understanding of what works in professional development and why. This technique contributes to actionable insights by highlighting the elements of training programs that are consistently valued by teachers and linked to improved teaching practices.

Contributions to Actionable Insights

The use of these analytical and interpretative techniques across the fifteen studies has significantly

contributed to actionable insights for program improvement. One of the key contributions is the identification of the specific components of professional development that are most effective in enhancing teaching practices. For instance, regression analysis and meta-analysis have consistently highlighted the importance of sustained, content-focused professional development that is closely aligned with teachers' instructional needs. These findings suggest that professional development programs should prioritize ongoing, in-depth training in specific subject areas rather than one-time, generalized workshops.

Another important insight is the need for contextualized and adaptable programs. Case studies and thematic analysis have shown that the effectiveness of in-service training is heavily influenced by the context in which it is implemented. Programs that are flexible and responsive to the unique challenges and opportunities within specific schools or regions are more likely to succeed. This underscores the importance of designing professional development initiatives that are not only evidence-based but also tailored to the specific needs of teachers and students in different settings.

Moreover, the use of longitudinal analysis and mixed-methods approaches has revealed the importance of continuous support and follow-up in professional development. The studies by Mukhopadhyay and Sharma (2008) and Timperley *et al.* (2007), among others, have demonstrated that without sustained support, the initial gains from professional development can quickly dissipate. This finding highlights the need for professional development programs to include mechanisms for ongoing mentoring, coaching, and collaboration among teachers, ensuring that new skills and knowledge are fully integrated into teaching practices over time.

Finally, these studies have contributed to a deeper understanding of the complexities involved in evaluating professional development programs. The use of sophisticated analytical techniques, such as regression analysis and meta-analysis, has enabled researchers to isolate the specific factors that contribute to program success, while interpretative techniques like thematic analysis and case studies have provided rich, contextual insights into how these factors play out in practice. Together, these

techniques offer a powerful toolkit for educators and policymakers looking to design, implement, and refine in-service teacher education programs that are both effective and sustainable.

In conclusion, the analytical and interpretative techniques employed in the fifteen studies reviewed have been instrumental in identifying patterns, relationships, and themes in data collected from in-service teacher education programs. These techniques not only provide a deeper understanding of what makes professional development effective but also offer actionable insights that can inform the ongoing improvement of these programs. By integrating quantitative and qualitative methods, contextualizing findings, and focusing on long-term outcomes, these studies offer a roadmap for designing professional development initiatives that truly enhance teaching practices and student learning.

DISCUSSION

The landscape of assessing in-service teacher training programs has evolved significantly over the years, with a marked shift towards more sophisticated and holistic evaluation methods. Traditionally, assessments focused primarily on short-term outcomes, such as immediate teacher reactions and basic knowledge acquisition. However, recent trends indicate a growing emphasis on long-term impacts, including sustained changes in teaching practices and student learning outcomes. This shift is reflected in the increasing use of longitudinal studies, mixed-methods approaches, and advanced statistical analyses like regression and meta-analysis.

Longitudinal studies, as highlighted by Darling-Hammond *et al.* (2009), are becoming more prevalent as they allow for the tracking of changes in teaching practices and student performance over extended periods. These studies provide a more comprehensive understanding of the lasting effects of professional development, revealing which components of training programs contribute to sustained improvements. Similarly, mixed-methods approaches, as employed by Mukhopadhyay and Sharma (2008) and Batra (2014), have gained traction for their ability to triangulate data from various sources, offering a richer, more nuanced analysis of program effectiveness.

Moreover, there is a growing trend towards incorporating context-specific evaluations. Studies like those by Kumar and Khare (2012) emphasize the importance of tailoring assessment techniques to the unique challenges and opportunities within specific regions, such as rural or urban settings. This trend aligns with the broader move towards more personalized and adaptive professional development programs, which are designed to meet the specific needs of teachers and students in different contexts.

Another emerging trend is the use of technology in assessment. Digital tools and platforms are increasingly being integrated into the evaluation process, enabling more efficient data collection, analysis, and reporting. This innovation not only enhances the accuracy and timeliness of assessments but also allows for more interactive and engaging evaluation methods, such as digital portfolios and online feedback systems.

The findings from the reviewed studies align with broader trends in educational research that emphasize the importance of comprehensive, context-sensitive, and data-driven approaches to assessing in-service teacher training programs. For example, the use of mixed-methods approaches and longitudinal studies has been widely recognized as a best practice in the field (Desimone *et al.* 2002; Borko, 2004). These techniques provide a more complete understanding of how professional development impacts teaching practices and student outcomes, allowing for more informed decisions about program design and implementation.

However, there are also areas where the findings diverge from other research. For instance, while the emphasis on context-specific evaluations is widely supported, some studies suggest that overly localized assessments may limit the generalizability of findings and hinder the sharing of best practices across different contexts (Kennedy, 2016). This tension highlights the need for a balanced approach that respects local context while also contributing to broader knowledge and practice in the field.

The discussion around the use of digital tools in assessment also reflects a growing trend in educational research and practice. While studies like those by Sparks and Loucks-Horsley (2003) emphasize the potential of digital platforms to

enhance assessment processes, others caution against over-reliance on technology, particularly in contexts where access to digital resources may be limited (Wei *et al.* 2009). This debate underscores the importance of considering the local context and ensuring that technological solutions are accessible and appropriate for the intended users.

In conclusion, the evolving trends in assessment techniques, the specific challenges and opportunities in the context of Odisha, and the broader considerations for comprehensive assessment all point to the need for a multifaceted and flexible approach to evaluating in-service teacher training programs. By integrating a range of analytical and interpretative techniques, involving multiple stakeholders, and maintaining a focus on equity and inclusion, educators and policymakers can ensure that professional development programs are both effective and responsive to the diverse needs of teachers and students.

Ways Forward in the Comprehensive Assessment of In-Service Teacher Training Programs

To advance the comprehensive assessment of in-service teacher training programs, it is essential to build on the evolving trends and lessons learned from various studies, both within and outside of India. One key area for development is the standardization of assessment frameworks. While context-specific evaluations are crucial, there is also a need for a common set of metrics and benchmarks that can be used to assess the effectiveness of professional development programs across different contexts. This standardization would enable more consistent and comparable evaluations, facilitating the sharing of best practices and the scaling of successful initiatives.

Another critical area is the integration of continuous and formative assessment methods into the evaluation process. Instead of relying solely on summative assessments conducted at the end of training programs, ongoing assessments could provide real-time feedback to both trainers and participants. This approach, as highlighted in studies like those by Timperley *et al.* (2007), would allow for the timely identification of areas where additional support or adjustment is needed, thereby enhancing the overall effectiveness of the training.

Moreover, there is a growing recognition of the importance of involving multiple stakeholders in the assessment process. Effective professional development does not happen in isolation; it is influenced by various factors, including school leadership, community support, and educational policies. As such, comprehensive assessments should involve not only teachers and trainers but also school administrators, policymakers, and even students. This multi-stakeholder approach, as suggested by Opfer and Pedder (2011), would ensure that assessments capture the full range of influences on teacher development and provide a more accurate picture of program effectiveness.

Finally, the way forward must include a stronger focus on equity and inclusion in the assessment of in-service teacher training programs. As studies like those by Avalos (2011) and Kumar and Khare (2012) have shown, teachers in different contexts, particularly those in rural or marginalized communities, face unique challenges that can significantly impact the outcomes of professional development. Assessments must therefore be designed to identify and address these disparities, ensuring that all teachers have access to high-quality professional development that meets their specific needs.

Way forward for the Teacher Training Programs in Odisha

The assessment of in-service teacher training programs in Odisha, like in many other regions, can benefit from several enhancements to better capture the complexities and nuances of teacher development and its impact on student outcomes. Current assessment practices in Odisha often rely on traditional methods, such as post-training surveys and basic classroom observations, which, while useful, may not fully capture the depth of changes in teaching practices or the broader context within which these changes occur.

One area for improvement is the adoption of more comprehensive and context-sensitive assessment techniques. For example, longitudinal studies, which have been successfully used in other contexts (Darling-Hammond *et al.* 2009), could be implemented in Odisha to track the long-term effects of teacher training programs. These studies would provide valuable insights into how training

influences teaching practices and student learning over time, beyond the immediate post-training period.

Additionally, the use of mixed-methods approaches, as suggested by Batra (2014), could enhance the depth and breadth of assessments in Odisha. By combining quantitative data (e.g., student performance metrics) with qualitative insights (e.g., teacher interviews and classroom observations), evaluators could develop a more holistic understanding of the effectiveness of training programs. This approach would also allow for the identification of contextual factors, such as socio-economic conditions and local educational policies, that may influence the outcomes of professional development initiatives.

Furthermore, there is a need to incorporate more advanced statistical techniques, such as regression analysis and meta-analysis, into the assessment process. As demonstrated by Garet *et al.* (2001), these techniques can help isolate the specific components of training programs that are most effective, enabling policymakers and educators to refine and target their professional development efforts more precisely. In the context of Odisha, where resources may be limited, such targeted approaches could maximize the impact of training programs by focusing on the most impactful strategies.

To address the unique challenges faced by teachers in Odisha, particularly in rural and under-resourced areas, the assessment process should also consider the integration of digital tools and platforms. As digital technology becomes more accessible, it offers an opportunity to enhance data collection and analysis in regions where traditional methods may be challenging to implement. For instance, mobile-based assessment tools could be used to gather real-time feedback from teachers, while online platforms could facilitate peer learning and support, thereby enriching the overall evaluation process.

The assessment of in-service teacher education programs requires a careful selection of data collection tools and techniques to ensure a comprehensive evaluation. Quantitative methods provide the necessary statistical rigor and generalizability, while qualitative methods offer deeper insights into the contextual and experiential factors that influence program outcomes. Mixed-methods approaches,

which integrate both quantitative and qualitative data, are particularly effective in capturing the full complexity of professional development programs, ensuring that all aspects of their impact are thoroughly assessed. As demonstrated by the 15 studies summarized in this analysis, the use of diverse data collection methods is crucial for understanding the effectiveness of in-service teacher education programs and for informing the design of future initiatives that can effectively improve teaching practices and student outcomes across different contexts.

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