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The Effectiveness and Challenges of PowerPoint in Mathematics Teaching: A Study from Solapur District, India

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Abstract:

This study investigates the role of PowerPoint (PPT) in teaching mathematics across schools and colleges in Solapur district, Maharashtra. Results indicate that students find PPT presentations engaging and helpful, particularly for diagrams and graphs, while teachers note its value for step-by-step explanations and time efficiency. However, infrastructural problems such as irregular electricity, shortage of projectors, and lack of training limit effective use. The study concludes that PPT can significantly enhance comprehension and student interest, but its potential will be fully realized only through improved resources, teacher training, and a blended approach that combines PPT with traditional blackboard teaching.

Keywords — Mathematics teaching, PPT, Solapur district, ICT in education.

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I. INTRODUCTION

Mathematics is often considered one of the most difficult subjects by students due to its abstract nature. Teachers are constantly searching for innovative methods to make learning easier and more engaging. The integration of technology into classrooms has become a global trend. Among various ICT tools, PowerPoint (PPT) presentations are simple, accessible, and widely used.

Solapur district in Maharashtra is known for its educational institutions ranging from schools to colleges and universities. However, many mathematics teachers still rely mainly on the chalk-and-board method. This study focuses on the role of PPT in mathematics teaching in Solapur district, analyzing both teachers' and students' experiences.

II. LITERATURE REVIEW

The integration of Information and Communication Technology (ICT) into education has been a subject of extensive research, with numerous studies across India and internationally consistently demonstrating its positive impact on student engagement and understanding. For instance, Sharma (2019) underscored the critical role of visual aids in mathematics education, a principle that aligns well with the visual capabilities of PPT. Further supporting this, Kulkarni (2021) found that technology-assisted teaching contributes significantly to improving conceptual clarity in mathematics. Beyond these general benefits, broader research, such as a review of PPT usage in mathematics teaching in Solapur district, also highlights the value of PPT in stimulating student interest, aiding comprehension and memory, attracting attention, cultivating logical thinking, and encouraging active participation. From a classroom management perspective, PPT is noted for improving teaching efficiency, expanding course capacity, making lessons more vivid, and activating the classroom atmosphere. Furthermore, in terms of knowledge presentation, PPT is recognized for its

ability to highlight key points, simplify complex concepts, and intuitively and dynamically display abstract mathematical knowledge.

However, despite these widely acknowledged benefits, studies conducted in rural areas often report common challenges that hinder effective technology integration, such as inadequate facilities and insufficient teacher training. This consistency in findings across various studies suggests a universal pedagogical benefit of ICT, but also indicates that infrastructural and human capacity challenges are not isolated incidents; rather, they represent systemic barriers to technology adoption in developing contexts. This implies that effective solutions must be comprehensive, addressing both pedagogical integration and foundational resource provision.

Crucially, while there is a growing body of general research on ICT in education, a significant gap remains in studies specifically focusing on the use of PPT in mathematics teaching within Solapur district. This study was therefore designed to fill this specific geographical and contextual void by providing localized evidence directly relevant to Solapur's unique educational environment. This need for localized evidence is further underscored by broader research gaps identified in other contexts, such as the Chinese literature review. That review noted that previous research methods were often singular (primarily literature reviews), leading to concentrated conclusions and a lack of deep discussion on the *value* of PPT itself. It also pointed out limited focus on the *disadvantages and shortcomings* of PPT, and insufficient in-depth discussion on *teachers' ability requirements*. Furthermore, the feasibility of conclusions regarding PPT use skills was questioned due to a lack of verification, and there were few studies specifically on the *senior high school stage*. Interestingly, the Chinese review also noted an absence of relevant surveys on *students' attitudes towards PPT* , a point that the Solapur study directly addresses. This contrast makes the Solapur study more comprehensive in certain aspects than the general trend observed in Chinese research, demonstrating that while broad research trends might be "concentrated," individual empirical studies can offer nuanced, on-the-ground data that refines or even challenges broader literature reviews. The explicit need for localized evidence is not just about adding to academic knowledge, but about providing actionable, context-specific data for local policymakers and educators, as generic recommendations might not be effective or feasible without such detailed understanding.

III. OBJECTIVES OF THE STUDY

The study was designed with clear and comprehensive objectives to thoroughly assess the role of PowerPoint (PPT) in mathematics teaching within Solapur district. These objectives served as a roadmap for the research, guiding the data collection and analysis to ensure a holistic understanding of the subject.

The specific objectives were:

- To study the overall role and impact of PPT in mathematics teaching within Solapur district. This objective aimed to understand the general function and influence of PPT as a teaching tool in the local mathematics classrooms.
- To understand students' opinions and perceptions regarding PPT-based mathematics teaching. This focused on gathering direct feedback from the learners themselves about their experiences and preferences.
- To identify the specific problems and challenges faced by teachers while using PPT in mathematics classrooms. This objective sought to uncover the practical difficulties and obstacles encountered by educators in integrating PPT.
- To propose actionable suggestions and improvements for enhancing the effective and sustainable use of PPT in classrooms. This forward-looking objective aimed to provide practical recommendations based on the study's findings.

The inclusion of both positive aspects (role, opinions) and negative aspects (problems), culminating in actionable suggestions, indicates a practical, problem-solving orientation for the study rather than a purely descriptive analysis. This means the study was designed not just to describe the current situation, but to diagnose issues and prescribe solutions, making it directly relevant for policy and practice in Solapur. This approach moves beyond simply acknowledging effectiveness to actively seeking ways to *improve* and *sustain* that effectiveness, which is crucial for real-world impact in educational development.

IV. METHODOLOGY

The study employed a survey-based approach to investigate the use of PowerPoint (PPT) in mathematics teaching within Solapur district. The research was conducted in selected schools and colleges across the district, with a deliberate effort to include both urban and rural institutions. This inclusive selection was crucial to ensure that the diversity inherent to Solapur district was adequately reflected in the study's scope, thereby enhancing the local relevance of the findings.

A total of 70 participants were randomly selected for the study. This sample comprised 50 students and 20 teachers. While the total sample size is modest for a district-wide study, the random selection method aims to minimize bias within the chosen institutions. The inclusion of both urban and rural settings, however, significantly strengthens the representativeness of the findings within Solapur itself, allowing for insights into potential disparities in infrastructure and access that are common in diverse geographical areas.

Data collection employed a mixed-methods approach, utilizing both quantitative and qualitative tools to gather comprehensive information. The primary instruments were:

- **Questionnaires:** These were administered to both students and teachers to collect structured data on their experiences and preferences. The student questionnaire included questions such as whether they liked PPT teaching, if it helped them understand concepts better than traditional methods, which topics they found easier with PPT, if they desired regular PPT use, and what problems they faced. For teachers, questions covered their frequency of PPT use, perceived advantages, problems encountered, training received, and their opinion on whether PPT should replace traditional board teaching.
- **Informal Interviews:** These were conducted specifically with teachers to gain deeper qualitative insights into their challenges, perspectives, and practical experiences that might not be fully captured through structured questionnaires.

The responses collected from both the questionnaires and informal interviews were analyzed using a combination of methods. Percentages were used to quantify trends and preferences, such as the proportion of students who favored PPT teaching. Qualitative observations, derived from the open-ended responses in questionnaires and the detailed discussions in interviews, were used to interpret underlying themes and patterns in the experiences and opinions of both teachers and students. This methodological choice, combining quantitative data with qualitative depth, provides a more robust and holistic understanding, moving beyond simple statistical figures to capture the nuanced "why" behind the observations, thereby strengthening the validity and applicability of the results. This approach contrasts with the "single research methods" noted in some broader literature reviews , suggesting the Solapur study adopted a more comprehensive approach in its data gathering.

V. KEY FINDINGS

The study's main findings illuminate both the significant benefits and the substantial challenges associated with the use of PowerPoint (PPT) in mathematics teaching within Solapur district.

Student Perceptions and Engagement with PPT Teaching

The study revealed a strong positive inclination among students towards PPT teaching in mathematics. Approximately 80% of students

expressed a liking for PPT-based instruction. Their reasons for this preference were clear: they found PPT presentations to be attractive and colorful, and particularly effective in aiding their understanding of complex diagrams and graphs. This strong preference for PPT due to its visual appeal and clarity in specific areas (like diagrams and graphs) points to its strength as a visualization tool.

Conversely, about 20% of the students indicated a preference for traditional blackboard teaching, especially for solving problems. This finding is not merely a statistical split but offers a crucial pedagogical insight. It suggests that while PPT excels at presenting concepts and visuals, it may be less suitable for the dynamic, interactive, and often iterative process of problem-solving. This implies that PPT should be viewed as a powerful complementary tool rather than a standalone replacement, directly leading to the recommendation for a blended approach. The optimal effectiveness of PPT appears to be topic-dependent, excelling where visual clarity and engagement are paramount, but less so where real-time, interactive problem-solving is required.

To provide a clearer overview of student preferences, the following table summarizes the findings:

Table 1: Student Preferences for PPT vs. Traditional Teaching in Mathematics

Preference	Percentage of Students	Reasons for Preference
Like PPT Teaching	~80%	Attractive, colorful, helps in understanding diagrams and graphs
Prefer Traditional Board Teaching	~20%	Especially for solving problems

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This table is valuable because it quantifies student attitudes, providing clear evidence of their preferences. The breakdown by *reason* (attractiveness, diagrams vs. problem-solving) is crucial for understanding *why* students prefer certain methods, directly informing the recommendation for a blended approach. It moves beyond a simple "yes/no" to a more nuanced understanding of effectiveness.

Teacher Experiences: Advantages and Preparation Time

Teachers in Solapur largely recognized the benefits of using PPT in mathematics instruction. Most teachers agreed that PPT significantly helps them save time during classroom instruction and facilitates the presentation of solutions in a clear, step-by-step manner. This indicates that PPT aids in structured content delivery and can streamline the teaching process within the classroom.

However, a notable concern raised by some teachers was the considerable extra time required for preparing effective PPT slides. This creates what can be described as a "preparation paradox." Teachers appreciate PPT for saving time *during* class and enabling structured solutions, yet the significant "extra time" required for preparation presents a substantial practical barrier. This trade-off means that while PPT enhances efficiency in one phase (delivery), it demands a substantial investment in another (preparation). This burden can deter teachers from consistent PPT use, even if they recognize its in-class benefits, highlighting a critical need for support in content creation or streamlined tools.

Infrastructural and Training Challenges Faced by Teachers

The study identified several common and significant problems that severely hinder the effective and widespread use of PPT in mathematics classrooms in Solapur. These are not minor operational issues but fundamental deficiencies.

The primary challenges were:

- **Shortage of Projectors:** A clear lack of essential display equipment in classrooms, which is crucial for projecting PPT presentations.
- **Irregular Electricity Supply:** This was particularly prevalent in rural areas, making the consistent and reliable use of electronic equipment like computers and projectors highly unpredictable.

- **Lack of Training:** Many teachers reported insufficient training in developing effective and engaging PPT presentations, suggesting that even when equipment is available, pedagogical skills for leveraging the technology are lacking.

These identified challenges are not isolated incidents but represent fundamental infrastructural and human capital deficiencies. Without reliable power and display equipment, PPT is simply unusable. Without adequate training, even available technology cannot be leveraged effectively to its full potential. This indicates that successful technology integration is not merely about teacher willingness or student interest; it is fundamentally dependent on the *systemic readiness* of the educational environment. Addressing these foundational issues is a prerequisite for realizing the pedagogical benefits of PPT.

To provide a clear summary of these critical challenges, the following table is presented:

Table 2: Common Challenges Faced by Teachers Using PPT in Solapur District

Challenge	Description
Shortage of Projectors	Insufficient availability of essential display equipment in classrooms.
Irregular Electricity Supply	Unreliable power, especially in rural areas, hindering consistent electronic device use.
Lack of Training	Insufficient professional development for teachers in creating effective PPTs.

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This table is valuable because it systematically lists the practical obstacles, making them easy to grasp. These are the *root causes* of implementation difficulties. Clearly presenting these challenges directly justifies the recommendations for resource provision and training, demonstrating that the proposed solutions are directly addressing identified problems. It highlights the gap between aspiration and reality in technology adoption.

Overall Impact on Mathematics Learning

The overall findings of the study suggest that PPT teaching has a significant positive impact on student interest in mathematics. More importantly, the study concluded that PPT has the potential to improve mathematics learning, especially when it is utilized in conjunction with traditional teaching methods. This conclusion is critical because it implies that the full potential of PPT is unleashed not by replacing traditional methods, but by *synergistic integration*. This "blended approach" is a pragmatic and effective strategy that acknowledges the strengths of both modes (PPT for visuals and engagement, blackboard for interactive problem-solving) and adapts to the existing infrastructural constraints, making it the optimal path for Solapur. It emphasizes that the benefits are conditional on a thoughtful combination of teaching tools.

VI. DISCUSSIONS

The study on PPT use in mathematics teaching in Solapur provides insights that strengthen the wider debate on technology in education. Most students reported that PPT was engaging and effective for understanding visual concepts, echoing findings from Sharma (2019) and Kulkarni (2021), who confirmed the value of ICT in improving clarity through visuals. Teachers, too, appreciated PPT for saving class time and simplifying step-by-step explanations, consistent with research elsewhere that highlights PPT's role in improving efficiency and making abstract ideas clearer.

However, recurring challenges in Solapur—such as lack of projectors, unreliable electricity in rural areas, and limited teacher training—mirror problems seen in other developing regions. These barriers show that the shortcomings of PPT are not due to the tool itself but to the surrounding infrastructure and human capacity. The Solapur study helps fill a research gap by explicitly addressing these practical issues, which are often overlooked in broader literature.

The findings suggest that while PPT can make mathematics more engaging, its benefits are limited unless paired with other methods. Students preferred PPT for diagrams and visuals but valued

the blackboard for problem-solving. Hence, a **blended approach** emerges as the most effective strategy: using PPT for visual explanations and the blackboard for interactive, step-by-step work. This balance not only reduces risks from unreliable infrastructure but also lessens the preparation burden on teachers. Ultimately, the question is not whether PPT is effective, but how it can be integrated sustainably into real-world classroom settings.

VII. Conclusion and Recommendations

The study conclusively demonstrates that PowerPoint (PPT) teaching in mathematics is both useful and effective within Solapur district. Students consistently find PPT presentations interesting and easier to follow, particularly praising their attractive and colorful nature and their utility in understanding complex diagrams and graphs. Teachers, too, recognize the practical benefits of PPT, noting its ability to save time during lessons and facilitate the step-by-step presentation of solutions. This positive reception from both learners and educators underscores PPT's significant potential to enhance mathematics education in the region.

However, the widespread and sustainable implementation of PPT is significantly hindered by several persistent challenges. These include a critical shortage of projectors, an unreliable electricity supply, especially in rural areas, and a notable lack of adequate training for teachers in creating effective PPTs. These are not merely logistical inconveniences but fundamental barriers that prevent the full realization of PPT's pedagogical advantages. The study's findings strongly advocate for a blended teaching approach, combining the strengths of PPT with traditional blackboard methods, as the most effective strategy to optimize learning outcomes and build resilience against these infrastructural limitations.

To enhance and sustain the effective use of PPT in mathematics teaching within Solapur district, the following concrete and actionable recommendations are proposed:

- **Provide reliable electricity and projector facilities:** This is a fundamental and non-negotiable requirement. Schools and colleges must ensure consistent power supply, especially in rural areas, and equip classrooms with a sufficient number of functional projectors. Addressing these basic infrastructural gaps is the first step towards enabling consistent access to and functionality of PPT. This direct link between the problem (lack of resources) and the solution (provision of resources) highlights a critical causal relationship: without these foundational elements, the pedagogical benefits of PPT cannot be consistently realized.
- **Offer training workshops for teachers to prepare effective PPTs:** Training should extend beyond basic technical skills to encompass pedagogical strategies for designing engaging, interactive, and mathematically sound presentations. Furthermore, workshops should focus on efficient preparation techniques to help reduce the time burden on teachers. This directly addresses the identified problem of "limited training" and the "preparation paradox" faced by educators. This implies that investing in human capital through targeted professional development is as crucial as investing in hardware.
- **Encourage blended teaching methods for problem-solving:** Schools and colleges should actively promote and support a pedagogical approach that integrates PPT presentations with traditional blackboard methods. For instance, PPT can be effectively used for concept introduction, presenting complex visuals, and displaying graphs, while the blackboard remains invaluable for dynamic, step-by-step problem-solving and interactive exercises.

This approach leverages the unique strengths of both tools, aligns with student preferences, and builds resilience against potential technological failures. This strategy is a pragmatic response that optimizes learning by adapting to both the strengths of the technology and the realities of the existing infrastructure, ensuring that learning remains effective even when full technological reliance is not feasible.

In essence, the successful integration of PPT into mathematics teaching in Solapur district is a multi-faceted endeavor. It requires not only pedagogical innovation but also robust policy support, consistent resource allocation, and continuous professional development. With proper support in terms of infrastructure, training, and pedagogical guidance, PPT teaching can indeed make mathematics learning significantly more engaging and accessible across Solapur district, realizing its full potential. The study provides a clear blueprint for how these elements can be strategically aligned to foster effective and sustainable learning environments in similar contexts.

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