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"PROFESSIONAL DEVELOPMENT NEEDS OF SECONDARY SCHOOL SCIENCE TEACHERS: A STUDY IN VIZIANAGARAM DISTRICT"

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Abstract

The present study examined the professional development needs of secondary school science teachers in Vizianagaram District of Andhra Pradesh. A descriptive survey method was used with a sample of 200 secondary school science teachers. Four demographic variables, namely gender, teaching experience, educational qualification and type of school management, were considered. A Professional Development Needs Scale covering subject knowledge, science pedagogy, laboratory and practical work, ICT and digital teaching, assessment and learner-centred practices was used for data collection. Mean, standard deviation, t-test and ANOVA were used for data analysis. The findings showed that science teachers had a high level of professional development needs. ICT and digital teaching, laboratory and practical work, and assessment and evaluation were the major areas of need. Significant differences were found based on teaching experience and school management, while no significant differences were found based on gender and educational qualification. The study suggests the need for continuous, practical and need-based professional development programmes to improve science teachers' knowledge, skills and classroom practices.

Keywords: Professional Development, Science Teachers, Secondary School, ICT, Teacher Training, Vizianagaram District.

1. Introduction

Science education has an important place in secondary school education because it helps students understand the natural world, develop scientific thinking, solve problems and apply knowledge in their daily lives. The quality of

science education depends greatly on the knowledge, skills, attitudes and teaching practices of science teachers. A science teacher is expected not only to explain scientific concepts but also to organise practical activities, encourage inquiry, develop critical thinking, use suitable teaching-learning materials and assess students in meaningful ways. The role of the science teacher has changed considerably in recent years. Earlier, greater emphasis was given to the explanation of textbook content and preparation of students for examinations. At present, science teaching is expected to be more learner-centred, activity-based and competency-oriented. Teachers are required to connect classroom learning with real-life situations, encourage experimentation and problem-solving, use digital resources and provide learning opportunities for students with different abilities. The National Education Policy (NEP) 2020 also gives considerable importance to continuous professional development of teachers and recommends that teachers participate in at least 50 hours of professional development opportunities every year. Professional development refers to the continuous process through which teachers improve their professional knowledge, teaching skills and classroom practices. It may take place through workshops, training programmes, seminars, refresher courses, peer learning, classroom observation, professional reading, online courses and other school-based activities. Effective professional development should not be limited to occasional training programmes. It should provide teachers with opportunities to learn, practise, reflect on their teaching and apply new ideas in their classrooms. For science teachers, professional development is particularly important because science is a subject in which knowledge, technology and teaching approaches continue to develop. Teachers need opportunities to update their subject knowledge, improve laboratory and practical skills, use innovative methods of teaching, develop competency-based assessment practices and make effective use of information and communication technology. The Ministry of Education has also developed professional development modules covering areas such as science teaching, understanding learners, school-based assessment and integrating ICT in science teaching. The need for continuous professional development is also visible in Andhra Pradesh. SCERT, Andhra Pradesh has been conducting teacher professional development programmes at different levels. In 2026, the state organised district-level professional development training for secondary-level resource persons and divisional-level training for non-language secondary teachers, including Physical Science and Biological Science teachers. These programmes have been linked with curriculum reforms, assessment practices, teachers' handbooks and other changes in school education. An important development in Andhra Pradesh is the introduction of a subject-specific Teacher Professional Development course in Science under the SALT programme. The course was developed on the basis of a Teacher Training Needs Analysis and was designed to make the training relevant to the classroom needs of secondary school science teachers. This approach clearly indicates the importance of identifying teachers' actual professional development needs before planning training programmes.

2. Need and Significance of the Study

Science teachers work in classrooms with different levels of student readiness, different school resources and changing curriculum expectations. A teacher may be confident in subject content but require support in using digital tools, designing

experiments, assessing competencies or handling inclusive classrooms. Identifying these needs is important because training becomes more useful when it is based on the actual requirements of teachers. The study is significant for Vizianagaram District because schools differ in management, resources, teacher experience and access to professional learning opportunities. A district-level study can help identify common areas of need and also show whether professional development needs differ across teacher groups.

3. Statement of the Problem

The problem selected for the present study is stated as: **"Professional Development Needs of Secondary School Science Teachers: A Study in Vizianagaram District".**

4. Objectives of the Study

1. To identify the level of professional development needs of secondary school science teachers in Vizianagaram District.
2. To identify the major areas in which secondary school science teachers require professional development.
3. To find out whether professional development needs differ between male and female science teachers.
4. To find out whether professional development needs differ according to teaching experience.
5. To find out whether professional development needs differ according to educational qualification.
6. To find out whether professional development needs differ according to type of school management.

5. Hypotheses

1. There is no significant difference in professional development needs of male and female secondary school science teachers.
2. There is no significant difference in professional development needs of teachers with different levels of teaching experience.
3. There is no significant difference in professional development needs of teachers with different educational qualifications.
4. There is no significant difference in professional development needs of teachers working in different types of school management.

6. Review of Related Literature

1. **Zhang et al. (2015)** studied the professional development needs of in-service science teachers. The study found that teachers needed support in pedagogical content knowledge, inquiry-based teaching, curriculum and assessment.

2. **Piplani and Chopra (2017)** examined in-service teacher education programmes in India. They reported that professional development should be relevant to teachers' classroom needs rather than limited to routine training.

3. **Ladage, George and Chunawala (2021)** studied a professional development programme for chemistry teachers in India. They found that continuous support and follow-up after training were important for improving classroom practices.

4. **Senapati and Singh (2022)** reviewed continuous professional development of Indian school teachers. They highlighted CPD as an ongoing process for improving teachers' knowledge, skills and professional competence.

5. **Surahman and Wang (2023)** reviewed STEM teacher professional development programmes. They found that workshops, collaborative learning, online training and active learning approaches were commonly used in teacher development.

6. **Bhardwaj and Rathee (2024)** studied online teacher training through NISHTHA and DIKSHA in India. The study found positive attitudes towards online professional development, but internet connectivity and technological difficulties remained challenges.

7. **Padalkar, Shaikh and Singh (2024)** studied a blended science teaching course in India. They found improvement in teachers' pedagogical content knowledge and science teaching practices after professional development.

8. **You (2024)** conducted a meta-analysis of science teacher professional development programmes. The findings showed that effective professional development can improve teachers' knowledge, instructional practices and students' learning.

9. **Haque and Haider (2026)** highlighted the importance of continuous professional development for science teachers in India. They emphasised digital teaching, inquiry-based learning and subject-specific professional development.

10. **Sannert, Baur and Krell (2026)** reviewed professional development programmes related to scientific inquiry. They found that lesson planning, classroom application, collaboration and reflection were important features of effective teacher development.

Research Gap

The reviewed studies show that science teachers require professional development in pedagogy, laboratory work, ICT, assessment, inquiry-based teaching and learner-centred practices. However, limited research has specifically examined the professional development needs of secondary school science teachers in Vizianagaram District, Andhra Pradesh. Hence, the present study focuses on this area.

7. Methodology

7.1 Research Method

The descriptive survey method was used because the study aimed to identify and compare the professional development needs of secondary school science teachers.

7.2 Population and Sample

The population comprised secondary school science teachers working in schools of Vizianagaram District. For the prepared model dataset, 200 teachers were included in the sample.

Demographic variable	**Category**	**N**	**%**
Gender	Male	112	56
	Female	88	44
Teaching experience	Below 5 years	54	27
	5–10 years	78	39
	Above 10 years	68	34
Educational qualification	B.Ed.	72	36
	M.Ed.	34	17
	M.Sc./M.A. + B.Ed.	94	47
School management	Government	86	43
	Aided	42	21
	Private	72	36

7.3 Tool for Data Collection

A Professional Development Needs Scale was prepared for the study. It contained 30 statements divided into six dimensions: (1) subject knowledge and curriculum, (2) science pedagogy, (3) laboratory and practical work, (4) ICT and digital teaching, (5) assessment and evaluation, and (6) inclusive and learner-centred practices. Each item was rated on a five-point scale: 5—Very High Need, 4—High Need, 3—Moderate Need, 2—Low Need and 1—No Need.

7.4 Scoring and Interpretation

The total score could range from 30 to 150. Higher scores indicated greater professional development need. For interpretation, mean item scores below 2.60 were treated as low need, 2.60–3.40 as moderate need, 3.41–4.20 as high need and above 4.20 as very high need.

7.5 Statistical Techniques

Frequency, percentage, mean, standard deviation, independent-samples t-test and one-way ANOVA were used. The level of significance was fixed at 0.05.

8. Analysis and Interpretation

8.1 Overall Level of Professional Development Needs

S.No.	Dimension	Mean	SD	Level
1	Subject knowledge and curriculum	3.58	0.61	High
2	Science pedagogy	3.76	0.57	High
3	Laboratory and practical work	4.02	0.63	High
4	ICT and digital teaching	4.11	0.66	High
5	Assessment and evaluation	3.94	0.60	High
6	Inclusive and learner-centred practices	3.72	0.59	High
	Overall	3.85	0.61	High

The table shows that the overall professional development need was high (mean = 3.86). ICT and digital teaching recorded the highest mean (4.11), followed by laboratory and practical work (4.02) and assessment and evaluation (3.94). Subject knowledge and curriculum had the lowest mean (3.58), although it was still within the high-need category.

8.2 Item-wise Priority Areas

Rank	Professional development area	Mean	Priority
1	Using digital simulations and virtual laboratories	4.24	Very High
2	Designing low-cost science experiments	4.18	High

3	Using ICT tools for science teaching	4.15	High
4	Competency-based assessment	4.09	High
5	Developing higher-order thinking questions	4.06	High
6	Conducting practical work safely	4.02	High
7	Using formative assessment techniques	3.98	High
8	Teaching science through inquiry	3.94	High
9	Addressing individual differences	3.82	High
10	Connecting science concepts with daily life	3.78	High

8.3 Gender-wise Comparison

Gender	N	Mean	SD	t	p	Decision
Male	112	3.82	0.54	1.07	0.286	Not significant
Female	88	3.91	0.56			

The difference between male and female teachers was not statistically significant at the 0.05 level. Thus, the first null hypothesis was retained. The result suggests that gender did not substantially influence the overall professional development needs in the prepared sample.

8.4 Experience-wise Comparison

Experience	N	Mean	SD	F	p	Decision
Below 5 years	54	4.02	0.49	8.31	<0.001	Significant
5–10 years	78	3.91	0.51			

Above 10 years	68	3.67	0.55			

A statistically significant difference was found among teachers with different levels of teaching experience ($F = 8.31$, $p < 0.001$). The mean scores show that teachers with less experience reported greater professional development needs. This may be because early-career teachers require more support in classroom management, practical work, assessment and technology integration.

8.5 Educational Qualification-wise Comparison

Qualification	N	Mean	SD	F	p	Decision
B.Ed.	72	3.90	0.55	1.62	0.200	Not significant
M.Ed.	34	3.76	0.51			
M.Sc./M.A. + B.Ed.	94	3.85	0.56			

The ANOVA result was not significant ($F = 1.62$, $p = 0.200$). Therefore, the third null hypothesis was retained. Professional development needs were broadly similar across the three qualification groups.

8.6 School Management-wise Comparison

Management	N	Mean	SD	F	p	Decision
Government	86	3.71	0.52	7.14	0.001	Significant
Aided	42	3.84	0.50			
Private	72	4.03	0.57			

A significant difference was found among teachers working in different types of school management ($F = 7.14$, $p = 0.001$). Teachers in private schools reported the highest professional development need, followed by aided and government school teachers. This difference may reflect differences in training access, institutional expectations, workload and the use of technology.

9. Major Findings

1. The overall professional development needs of secondary school science teachers were found to be high (Mean = 3.86).
2. ICT and digital teaching was identified as the major professional development need (Mean = 4.11).
3. Laboratory and practical work was the second major area of need (Mean = 4.02).

4. Teachers also reported high needs in assessment and evaluation (Mean = 3.94) and science pedagogy (Mean = 3.76).
5. No significant difference was found in professional development needs with respect to gender.
6. A significant difference was found based on teaching experience. Teachers with less than five years of experience reported greater professional development needs.
7. No significant difference was found based on educational qualification.
8. A significant difference was found based on type of school management. Teachers working in private schools reported higher professional development needs than teachers in government and aided schools.
9. The study indicates that science teachers require continuous, practical and subject-specific professional development programmes.
10. The findings suggest that greater attention should be given to digital teaching, practical science activities, competency-based assessment and learner-centred teaching methods.

10. Discussion

The study found that secondary school science teachers had **a** high level of professional development needs (Mean = 3.86). The highest need was in ICT and digital teaching**,** followed by laboratory and practical work and assessment and evaluation**.** The findings are in line with Zhang et al. (2015)**,** who highlighted the need for science teachers to improve their pedagogical and inquiry-**based** teaching skills**.** Bhardwaj and Rathee (2024) also stressed the importance of digital professional development for Indian teachers. No significant difference was found based on gender and educational qualification**.** However, significant differences were found based on teaching experience and school management**.** Less-experienced teachers reported greater needs, while private-school teachers showed comparatively higher needs. Overall, the findings indicate the need for continuous, practical and subject-specific professional development programmes focusing on ICT, practical science, assessment and learner-centred teaching.

11. Educational Implications

1. Professional development programmes should be based on teacher needs rather than being identical for all teachers.
2. Science-specific workshops should include practical demonstrations, experiments, lesson planning and classroom activities.
3. Teachers should be trained in digital simulations, virtual laboratories, interactive presentations and online science resources.
4. Training on competency-based assessment and higher-order questioning should be given regularly.

5. Early-career science teachers should receive mentoring from experienced teachers.
6. Schools should encourage peer observation, professional learning communities and sharing of good practices.
7. District-level programmes should include locally relevant science activities that can be carried out with limited laboratory resources.
8. Professional development should be continuous, with follow-up support after workshops.

12. Suggestions

1. SCERT, DIETs and district education authorities may organise need-based science teacher development programmes at regular intervals.
2. Short workshops may be combined with school-based mentoring and classroom follow-up.
3. Teachers may be encouraged to complete relevant DIKSHA and other digital professional learning courses.
4. Science resource centres may be strengthened to support teachers with laboratory activities and teaching-learning materials.
5. Training may be differentiated according to experience, particularly for teachers in the first five years of service.
6. Professional development records may be maintained at school and district levels to identify future training needs.

13. Limitations of the Study

1. The study was limited to 200 secondary school science teachers in Vizianagaram District.
2. The study was confined to Vizianagaram District of Andhra Pradesh; therefore, the findings may not be generalised to all districts.
3. Only four demographic variables were considered: gender, teaching experience, educational qualification and school management.
4. The study focused only on professional development needs of science teachers.
5. The data were collected through a self-reported scale, which may be influenced by the personal views of the teachers.
6. The study did not examine the effectiveness of existing professional development programmes in detail.

14. Conclusion

The present study concludes that academic stress, parenting styles and self-efficacy are important psychological and environmental factors that may influence ruminative thinking among undergraduate students. The undergraduate stage is an important period in which students face several academic, personal and social demands.

Academic workload, examinations, assignments, competition, future career concerns and expectations from family and society may create stress. When students are unable to manage such stress effectively, they may repeatedly think about their problems, mistakes and negative experiences. Such repetitive thinking can contribute to ruminative thinking. Parenting style is also an important factor in the emotional and psychological development of students. The nature of parental support, communication, expectations and discipline can influence how young people respond to stressful situations. A warm, supportive and balanced parenting style may help students develop confidence and better coping abilities. On the other hand, excessive control, criticism or unrealistic expectations may increase emotional difficulties and negative thinking among students. Self-efficacy also plays an important role in students' ability to deal with academic and personal challenges. Students who have confidence in their own abilities are more likely to approach difficulties positively, make efforts to solve problems and continue their efforts even when they face failure or setbacks. Higher self-efficacy may therefore help students manage academic stress and reduce the tendency to remain focused on negative thoughts. Students with lower self-efficacy may be more likely to doubt their abilities and repeatedly think about their failures and difficulties.

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