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Enhancing Students' Science Achievement through Teachers' Accountability: A Mixed-Methods Study

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Keywords

Accountability, learning achievement, practices, perspectives, science, teacher

Abstract

Teachers play a pivotal role in fostering their students' personal agency and guiding their future development. This study aims to examine the relationship between teachers' professional accountability and students' science achievement in school education. Employing a sequential explanatory mixed-methods design, the study explored the perspectives of students, teachers, and parents regarding teachers' accountability practices and their impact on science achievement. Quantitative data were collected through a science achievement test administered to 608 grade eight students in 24 schools, including 12 community and 12 institutional schools by disproportionate stratified sampling followed by simple randomization, across the Kathmandu Valley, along with an accountability survey conducted with the same students, 252 parents whose children were involved in the achievement test, and 31science teachers at grade eight. Qualitative data were collected through in-depth interviews with 12 purposively selected students and four teachers from four case schools. Schools with higher levels of teachers' accountability tend to show higher science achievement. Teachers' accountability practices vary across schools and lack a systematic approach to monitoring, supporting, communicating, reporting, and collaborating for quality science education. The study found a prominent role of teachers' accountability in increasing students' science achievement. Changes to current practices require improvement in schools' academic abilities. Practices often involve multiple actors, diffusing and institutionalizing new ways of working, creating effective feedback loops, managing required resources, and developing teachers' capacity.

Introduction

An effective education system demands the development of an educational ecosystem with strong inputs and well-managed processes, as these are essential foundations for ensuring accountability and achieving desirable learning outcomes. The debate around accountability in education gained momentum following the enactment of the *No Child Left Behind Act* (NCLB) in the United States in 2002 (Martinez, 2017). Following NCLB, worldwide education reform initiatives have increasingly focused on holding schools accountable for their students' performance (Hanushek & Raymond, 2005; Judson, 2010; Ryan, 2005). Accountability systems are regarded as part of educational reform and other public-sector management (Organisation for Economic Co-operation and Development [OECD], 2009). NCLB policy focused on standards-based reform and increasing funding in public education. It mandates teachers to be held accountable for their students' learning achievement, regardless of their background and abilities (Judson, 2010). In the context of Nepal, the *School Education Sector Plan* (SESP, 2022/32) highlighted that the persistence of weak inputs, inadequate processes, and a weak accountability system remains a major challenge in Nepal's school sector (Ministry of Education, Science and Technology [MoEST], 2022). These are limiting the ability of school actors such as teachers, head teachers, and School Management Committees in creating a supportive, well-resourced, inclusive, and conducive learning environment that meets students' needs, fosters their motivation, engagement, and participation, and ultimately leads to lower learning outcomes (MoEST, 2022). UNESCO (2017) defines "accountability as a process that supports individuals or institutions in fulfilling their responsibilities and achieving their objectives"(p. 3). Bovens (2007) views accountability as a social relationship between a principal (forum) and an actor, highlighting that both obligation and responsiveness are fundamental features of an effective accountability system. Educational activities in schools rely on multi-level collaboration, shared responsibility, and mutual accountability. It requires all stakeholders—government, SMCs, head teachers, teachers, students, and parents—to fulfil their responsibilities, adhere to compliance standards, and work collaboratively to ensure quality teaching and learning, with teachers teaching, students learning, government bodies investing in and monitoring policy implementation, and parents actively engaging in their children's schooling.

Student results (exam scores) are widely regarded as a major indicator of school effectiveness in Nepal- especially in public reporting, policy discussions, and community perceptions. However, educational policies such as the *School Sector Reform Plan* (SSRP), *School Sector Development Plan* (SSDP), SESP, Education Acts, and the National Curriculum Framework also recognize the importance of teaching-learning processes, governance, and learning environments in determining overall quality. School accountability involves the process of assessing the effectiveness of schools, and result-driven accountability holds schools and teachers responsible for student outcomes, with academic achievement often used as a key indicator of school quality (Torres,

2021). In contrast, process accountability focuses on the quality of educational practices and procedures, emphasizing that effective processes are essential for achieving desirable learning outcomes. Ready (2012) found that standardized assessments are correlated with students' achievement, which may exert positive or negative effects. Studies found that students' achievement is shaped by the specific accountability practices functioning within schools (Ordofa & Asgedom, 2022; Shields et al., 2021). It is imperative that contextual understanding is essential before designing effective interventions, rather than relying on uniform best-practice models (Organization for Economic Co-operation and Development, 2014). Educational accountability operates across multiple dimensions, encompassing children's self-accountability for learning, teachers' professional accountability, head teachers' and SMCs managerial accountability, and the parental accountability towards their children's education. At the heart of education are the students, and it is teachers' professional accountability that shapes their learning and success. Teachers are obliged to fulfil the assigned roles and responsibilities and are held accountable for their professional conduct. Understanding teachers' professional accountability is therefore essential for improving science learning outcomes at the basic level of school education, as it directly influences both teaching quality and student achievement.

Educational Policies of Nepal and literature dealing with accountability and learning achievement were reviewed and major findings related to this study are discussed under different heads as follows.

Nepal's Educational Policy Perspective on Accountability in Education

Nepal has endorsed and implemented various sectorial educational plans and projects, some of which include *Basic and Primary Education Project* (BPEP Phase I and II), SSRP, SSDP, SESP, that emphasized the development and implementation of strategies to improve overall standards of education, improve institutional set-up, inclusive education, create a child-friendly school environment, provide scholarships for targeted groups, increase enrollment, improve curriculum, provide teacher training, and achieve education targets. The *National Curriculum Framework* (NCF, 2019) emphasizes improving teachers' performance in implementing curricula in their classrooms. It is provided in schools to develop multi-year individual school improvement plans (SIPs). The SIP is expected to help attain the goals and set targets. The SSRP sector-wide approach emphasized ensuring equitable access to quality basic education for all children. The *Education Rules* (2002) provided for the social audit of community schools to ensure compliance with policies, rules, regulations, and provisions.

Over the past decade, education policy has increasingly focused on improving schools by strengthening teacher accountability (Kraft et al., 2020). Recognizing the importance of accountability in school effectiveness, the *National Education Policy* (NEP, 2019) calls for making teachers accountable both to head teachers and students for students' learning outcomes. They are also held accountable to parents/communities

for their children's educational outcomes. Furthermore, the policy emphasizes result-driven accountability, making teachers responsible for improving teaching and learning by providing evaluations of teachers' performance based, among others, on students' examination results (MoEST, 2022). Recognizing this gap, SESP calls for a strengthened accountability framework that holds every school-level actor accountable for creating an enabling learning environment and advancing learning outcomes for all children in school education. The policy highlighted the lack of an effective system of accountability for students' learning and emphasized streamlining the education system to improve teachers' accountability. Furthermore, the policy emphasized the development and implementation of a teacher professional development system and establishing teacher support system. Key strategies suggested by the SESP for school improvement includes promoting good governance, improving school leadership system, integration of technology in management, developing a result-driven accountability system and effective monitoring and evaluation mechanism (MoEST, 2022).

Accountability and Learning Relationship

Although previous studies examined the role of accountability in education, very few of them have explored the correlation between teachers' accountability and students' achievement in school science. This study address this gap in the existing literature by focusing on professional accounts of teachers, not limiting to result-based evaluation system. Teachers' accountability is a multifaceted concept and goes beyond student achievement. In this regard, teachers act as agents of change, playing diverse roles and taking responsibility not only for students' academic results but also for every professional task they perform.

Students' achievement is widely regarded as a key criterion for evaluating the effectiveness of teaching and learning in schools. NCLB emphasizes standards-based reform, test-based accountability and public reporting of results in educational policy. In Nepal, Students' lower achievement and learning disparity in science is a significant concern for the government, policymakers, school administrators, teachers, parents, and other stakeholders. Results from BLE and SEE examinations, as well as NASA studies, consistently demonstrate the persistence of this issue (Education Review Office [ERO], 2020, 2022, 2025; MoEST, 2022). Despite increasing investment, initiatives, and implementation of numerous plans and programs, the outcomes have been disappointing. According to Bergsteiner (2012), accountability in a school system is shaped by three interconnected triggers: intentions (planning, decisions, and choices), actions (teaching practices and behaviours), and consequences (student outcomes). Literature suggests that Nepal's school education system often focuses narrowly on learning outcomes, overlooking how teachers plan and teach. Applying Bergsteiner's framework, a more effective school system would design accountability measures that assess all three dimensions-what teachers intended, how they acted, and what students achieved-leading to a more complete and fair understanding of school performance. Scholars distinguished two forms of accountability: external accountability and self-accountability.

External accountability refers to situations in which individuals or groups are held accountable to others, whereas self-accountability involves people taking responsibility for their own actions and holding themselves accountable for achieving their goals (Bergsteiner, 2012). External accountability, mechanisms imposed by higher authorities or agencies, is generally expected to ensure teachers meet quality standards and improve performance; however, excessive monitoring, administrative burden, compliance pressures, over-control, and sanctions can lead to teacher burnout, cause stress, reduce autonomy, practice teaching to test and reduce creativity as negative consequences. External accountability systems, such as school management and education authorities, employ both supportive and corrective strategies, including rewards, mentoring, feedback, training, and support, to strengthen teachers' accountability for student learning outcomes. Self-accountability involves teachers taking ownership of their professional actions and outcomes through reflective practice. It aligns with self-regulated learning principles and teacher agency, fostering personal responsibility through goal setting, enthusiasm, intentionality, self-evaluation, and responsibility for the consequences of their actions. Brett (2003) advocates the participatory principle over the hierarchical one. Instead of viewing accountability as a principal-agent problem (where one party controls and monitors the other), it should focus on shared understanding and mutuality among the multiple actors. Strengthening the accountability framework requires integrating reciprocal accountability among multiple actors, for example, the accountability of parents to the school and the school's accountability to its teachers (Brett, 2003).

Objectives of the Study

This study aims to examine the relationship between teachers' accountability and students' science achievement. Furthermore, students', teachers', and parents' perspectives towards teachers' accountability and teachers' accountability practices were explored. It also seeks to discover how different schooling models (community and institutional) differ in teachers' accountability practices, and how these differences might translate into students' science achievement at grade eight in Kathmandu Valley.

Methodology

This study employed a sequential explanatory mixed-methods design (Creswell, 2014), incorporating a survey for the quantitative phase and a case study for the qualitative phase. As mixed-methods researchers, we believe that reality is not singular or fixed but can be understood through different perspectives and lenses, using both objective and subjective forms of inquiry. The study was conducted in three districts of the Kathmandu Valley, including Bhaktapur Municipality in Bhaktapur District, Mahalaxmi Municipality in Lalitpur District, and Kathmandu Metropolitan City in Kathmandu District. The selected sites reflect the country's diversity in religion, caste, ethnicity, economic status, education, and classroom contexts, and include higher, medium, and lower-performing schools for study. For the survey, the study employed disproportionate stratified probability sampling followed by simple

randomization, ensuring that each member of the population had an equal chance of being selected (Teddlie &Tashakkori, 2009). A science achievement test, along with an accountability survey, was administered to 608 grade eight students in selected 12 community schools (Cs) and 12 institutional schools (Is), 252 parents whose children were involved in the achievement test, and 31science teachers teaching at grade eight participated in the survey. In the second phase, a case study approach was employed to collect qualitative data through in-depth interviews in four schools. Three students from each school (n = 12) were purposively selected based on their performance on a science achievement test administered for the study. High- and low-performing community and institutional schools were identified based on their students' science achievement scores. Within each selected school, students were purposively sampled for interviews and categorized as low, medium, and high achievers based on their performance.

The number of research participants is presented in Table 1.

Table 1. *Sample Distribution*

Study Phase	Schools	Teachers	Students	Parents
Quantitative	Community (12)	16	321	127
	Institutional (12)	15	287	125
	Total (24)	31	608	252
Qualitative	Community (2)	2	6	-
	Institutional (2)	2	6	-
	Total	4	12	-

Quantitative data were collected through a science achievement test administered to grade eight students in 24 selected schools, along with an accountability survey administered to students, parents, and teachers to measure their perspectives on accountability practices. The achievement test was designed using the Basic Level Examination specification grid, maintaining the content and cognitive domains, and was validated through a pilot study. Qualitative data were gathered through in-depth interviews with selected students and teachers to gain deeper insights into teachers' professional accountability practices and their impact on science achievement. Written consent was obtained from the schools and individual respondents to conduct this study. The study adhered strictly to methodological rigor and ethical standards throughout its design, implementation, and dissemination. Quantitative data were managed in Excel, transferred to SPSS-25, and descriptive and inferential statistics were performed. Reporting and discussion were undertaken using the thematic approach.

Results and Discussion

This result and discussion provide a comprehensive analysis of students' science achievement in relation to demographic variables and teachers' accountability practices. It further examines the correlations between science achievement and multiple dimensions of teacher accountability, including instructional quality,

classroom management, and professional responsibility. In addition, the section explores teachers' accountability practices and presents insights from teachers, students, and parents regarding accountability in education. The attempt is to provide a nuanced understanding of how demographic factors and accountability mechanisms interact to influence student performance in science.

Students' Achievement in Science by School Type

Students' achievement by school type has been analyzed using descriptive and inferential statistics (t-tests and ANOVA), and the results are presented in Table 1.

Table 2. *Comparison of Students' Achievement in Science by School Type*

School Type (Students)	Mean	SD	T	P	95%CI	Cohen's d
Community (N = 321)	34.38	16.649	-8.380	<0.01	-15.195 to	0.68
Institutional (N = 287)	46.69	19.274			-9.424	

Students in institutional schools (M = 46.69) scored significantly higher in science than those in community schools (M = 34.38), $t(568.68) = -8.380$, $p < .001$, Cohen's d = 0.68, indicating a medium effect size. It is also found that some community school students' average achievement scores are higher than those of some institutional schools. It was found that students' science achievement at the basic level was not satisfactory. There were school-wise disparities in students' science achievement, and community school students are struggling more in science. The study found that some community school students performed better than institutional schools, but there were only a few such community schools

Qualitative inquiry revealed persistence of many problems and challenges in the schools, including limited resources, insufficient facilities, poor school governance, traditional pedagogical practices and limited school-community collaboration. Disparities in school facilities were observed within and between community and institutional schools. It was found that schools with good facilities and those without them have very similar teaching and learning. It indicates that school facilities are important, but teachers' competencies, willingness and effective practices plays a more critical role in achieving desirable outcomes. In a lower-performing institutional school, a student said there is a lack of laboratory facilities, limiting hands-on learning. She mentioned that throughout the year, the science teacher demonstrated only two experiments and did not organize any science excursions, workshops, or group work. A low-performing student experienced discriminatory pedagogical practices in science class. She said the science teacher favours and prioritizes those students who are more vocal or secure higher ranks in class, but cares little about those who are less vocal and perform poorly. She suggested that "teachers should not judge all students in one frame. Every student is different and may have unique potential and capabilities". Another student from the same school also suggested that "teachers should treat every student equally and equitably, taking into account individual needs

and capabilities". A student from a low-performing community school reported that "the science teacher neither inquired about my performance nor initiated any personal discussion regarding it. There was no communication about my underperformance, and I did not receive any written feedback from the teacher. The students' point highlighted the epistemic injustice that prevailed in the schools. Epistemic justice calls for an inclusive and supportive approach in teaching and learning that ensures equal and equitable opportunities for students in the learning process (Paudel et al., 2024). Gender-wise comparisons showed the same trend: both male and female students in institutional schools outperformed their counterparts in community schools. The achievement gap among female students appears more substantial, indicating that those attending community schools experience comparatively greater barriers to science learning than their counterparts in institutional schools (M. diff.= 14.961, $t(234.208) = -7.148$, $p < .001$, 95% CI= -19.085 to -10.838, Cohen's $d = 0.84$).

The SSDP places a strong emphasis on improving the quality of education, prioritizing equitable access to overcome disparities faced by disadvantaged groups

Students' Science Achievement by Ethnicity and Parents' Education

Students' science achievement was compared for different ethnicities. ANOVA test analysis revealed a statistically significant difference in science achievement among students from different ethnic groups, $F(4) = 6.182$, $p < .001$. Data suggests mean achievement scores were highest for Brahmin/Kshetri students ($M = 44.98$), followed by Janajati ($M = 38.77$), Madheshi ($M = 37.92$), Others ($M = 36.32$), and lowest for Dalit students ($M = 28.77$). Because the assumption of equal variances was violated, Welch's ANOVA test was conducted. The analysis showed a significant effect, Welch's $F(4) = 7.658$, $p < .001$. These results indicate notable disparities in science performance across ethnic groups. Post hoc analysis using the Games–Howell test also revealed significant differences in science achievement among ethnic groups. Brahmin/Kshetri students consistently achieved the highest scores, while Dalit students had the lowest, highlighting substantial disparities in science achievement across ethnic groups.

The analysis of results underscores the strong influence of parental education on students' science achievement. Students whose parents or guardians had university-level education scored significantly higher in science than those whose parents were uneducated or had completed SLC or Intermediate level of education.

The result revealed that students from low-income communities, like historically marginalized Dalits, are still disadvantaged compared to others in the modern education system. Vulnerable students are likely to have limited access to resources or opportunities. The teacher can play an important role in supporting and ensuring equitable learning opportunities for students who are struggling to learn and facing challenges and problems associated with societal and family causes. Accountability system demands holding teachers responsible for their students' performance and ensuring each learner's academic success, so that

no student is left behind in the classroom. At national level, it is suggested for government to implement targeted intervention and additional support to families facing problems with their children's education.

Teachers' Professional Accountability: Perspectives and Practices

Teachers' accountability practices were measured on a Likert scale, with ratings from parents, students, and teachers across multiple accountability dimensions. Differences in practices between the two types of schools were examined using the Mann–Whitney U test. The internal consistency of items in accountability measurements is presented in Table 2.

Table 3. *Internal Consistency (Cronbach's alpha) of Items in Teachers' Professional Accountability Scale*

Teachers' Professional Accountability	Number of items	Cronbach's alpha (α)
Students reported	6	0.736
Parents reported	4	0.713
Self-reported	16	0.778

The data in Table 2 shows the good internal consistency of items in the group. It permits for further analysis of variables in a group. Individual items with Cronbach's alpha (α) abive 0.7 were considered for the analysis. This study revealed the teachers' professional accountability practices of community and institutional schools in Kathmandu as reported by students, parents and teachers.

Students from both types of schools reported lower satisfaction with ongoing teaching practices (M*IS* = 2.64, M*CS* = 2.73). In comparison, community school students reported higher student satisfaction with science lesson delivery (U = 40,320.50, p = .006, Cohen's d = 0.22). In contrast, institutional school teachers excelled in the use of students' evaluation practices (U = 37,661.00, p < .001, Cohen's d = 0.32). In contrast, institutional school teachers received slightly higher mean scores than community school teachers for meeting individual needs, monitoring students' progress and behaviour, and using feedback frequently; all mean scores were approximately 3 out of 5 points on a Likert scale. However, none of these differences was statistically significant (p > .05). These findings suggest that while certain accountability practices vary between school types, the overall practices appear broadly similar.

Parents' reported data revealed no significant differences between community and institutional school teachers in overall professional accountability practices and their dimensions, including effective communication, engaging tasks, reporting, and supportive behaviour (all ps > .05). Ratings for communication were very low (< 2), indicating limited contact with parents and inadequate sharing of student-related information. Institutional teachers performed significantly better in meeting with parents or contacting them regarding students' learning/

behaviour (U = 67.50, p = .047). Scores for reporting and providing engaging tasks ranged between 2 and 3, suggesting these as other weak areas. In contrast, supportive behaviour received relatively higher ratings across both school types, indicating teachers' positive behaviour. Bandele and Ajayi (2013) highlighted the need for teacher accountability and their collaboration with stakeholders, such as students, colleagues, parents, and society, to bring a positive effect on students' learning and the overall educational system. Teachers should be responsive to parents for their actions and dedicate more time to public relations (Maphosa et al. 2012; Rahmatollahi & Zenouzagh, 2021)

Analysis of teachers' self-reported accountability shows institutional school teachers demonstrated slightly higher professional accountability than community school teachers; however, the difference was not statistically significant at the 0.05 level (MCs = 3.06, MIs = 3.12; mean rank: Cs = 14.59, Is = 17.50; U = 97.50, p = .335). Although not significant (all Ps >0.05), slight differences were observed in activities such as formally observing other teachers' teaching (MCs = 2.06, MIs = 2.40), being observed by colleagues (MCs = 2.31, MIs = 2.40), meeting with head teachers to discuss about teaching and students' matter (MCs = 3.19 MIs = 3.60), developing strategic plans and teaching plan regularly (MCs = 3.50, MIs = 3.79) and engaging students in co-curricular activities (MCs = 3.19, MIs = 3.40), such as organizing STEM club activities, conducting action research, developing students' portfolio, and meeting/contacting parents to discuss about their children's learning and behavior at school (MCs = 3.44, MIs= 4.14). Conversely, community school teachers performed slightly better than institutional teachers in receiving formal feedback (MCs = 3.13, MIs = 2.87), collaborating and discussing with colleagues to improve teaching (MCs = 3.75, MIs = 3.47) and engaging in planning and reflection activities (MCs = 3.06, MIs = 3.12).

The data depict moderate professional accountability of community and institutional school teachers. Schools need to design a comprehensive framework to engage and evaluate teachers in fulfilling their roles and responsibilities and meeting the standards set under the accountability framework. An accountability framework for teachers provides clear expectations, performance indicators, a system of tracking activities and a mechanism for supporting improvement. The Teacher Competency Framework 2016 and the Teacher Trainer Competency Framework 2025 in Nepal (Centre for Education and Human Resource Development, 2025) provide contextual guidelines for designing and implementing a school teacher accountability framework.

Relationship Between Teacher Accountability and Student Science Achievement

Questionnaires with items on a five-point Likert scale were designed and administered during the field study to measure teachers' professional practices. Students' ratings of various aspects of teachers' professional accountability, along with their parents' ratings, were collected. These ratings were summed for each respondent and then analyzed using Pearson's correlation to examine their relationship with students' science achievement scores. The correlation statistics are presented in Table 3.

Table 4. *Correlation Statistics between Teachers' Professional Accountability and Science Achievement*

Teachers' Professional Accountability	Science Achievement R	P	R^2
Students reported based on individual scores	.235**	.000	0.06
Parents reported based on individual scores	-0.03	.961	-
Overall combined scores for schools	.638**	.001	0.41

Based on students' responses, the correlation between students' science learning achievement and teachers' professional accountability is positive, significant, but weak ($r = .235$, $p < 0.01$, $r^2 = 0.06$). This means that schools with higher levels of teachers' accountability tend to show slightly higher science achievement. An institutional school teacher (IJ) opined that "teachers must take the responsibility for students' learning and for shaping their future; therefore, they make it their utmost priority". In the same line, a community school female teacher (CL) also viewed teachers as most responsible for students' learning outcomes. She argued that "it is not solely the teacher's responsibility to ensure academic success; school management, the SMC, parents, and students must also fulfill their roles and responsibilities through collective accountability practices". Teacher CP from a high-performing community school opined that "taking credit for students' good performance while taking no responsibility for poor performance does reflect well on teachers".

The study found a negligible, slightly negative, but insignificant correlation ($r = -0.03$, $p = .961$) between parents' perceptions and observations of teachers' professional accountability and students' science achievement. The negative correlation, though negligible, suggests that higher student performance in science is associated with lower parental ratings of teacher accountability. This suggests a gap between parental expectations and teachers' practices in schools. In this regard, Thomas and Strunk (2017) found that Children's self-efficacy and parents' expectations significantly influence science achievement in Grade 5. A low-performing institutional school teacher, IJ, reported that "institutional school parents are more concerned about different aspects of their children's schooling. The heightened parental involvement leads to higher management attentiveness toward teachers and students". This finding calls for further research to understand why parents of high-achieving students perceive lower teacher accountability. Provision (expectation) – practice gaps are evident across schools (MoEST, 2022; Paudel et al., 2024). During interviews, teachers and students revealed that teachers' classroom practices are mostly lecture-based, book-content-based, followed by paraphrasing, and often lack hands-on and technology-integrated approaches. In science classes, it was found that teachers mostly enter class without a lesson plan and planned activities, and learners get very limited opportunities to experiential learning through hands-on activities (See also Milligan et al., 2025). Students reported that teachers often overlook the individual needs of learners, giving more attention to vocal and good-performing students. Anderson

(2011) reported that fact-based science teaching does not meet many students' learning needs. Najeeb (2012) mentioned that fostering learner independence leads to better learning outcomes. Overall, combined school scores for teachers' accountability showed a strong, positive, and significant correlation with students' science achievement. Effective learning requires meaningful engagement of learners in experiential, activity-based, problem-solving, critical thinking, collaborative, inquiry, and case analysis tasks (Bigg et al., 2018; Mebert et al., 2020). The schools where the managerial and academic ecosystem is functional, teachers bear greater responsibility with autonomy, and teachers adhere to professional standards tend to have better student outcomes in science. Teachers reported that accountability measures can either support or restrict engaging instructional practices. A wide range of factors influence teachers' professionalism (Ryder, 2015) and the impact of accountability on professional practices depends on its implementation. It either empowers or constrains teachers' practice. This study found that, as scholars (Anderson, 2011; Shuler et al., 2009) reported, to improve standardized test scores teachers' use of student-centered instruction, such as inquiry, project-based learning, constructivist learning, etc., gets sidelined, and hence system-wide improvements are required through educational innovations (Lee and Luykx, 2009). Accountability with clear expectations, set compliances, collaborative efforts, supportive feedback and collaborative tasks can foster better teaching and learning, while excessive compliance requirements may lead to stress, constrain autonomy, hinder professional growth and lead to result-oriented teaching (Anderson, 2011). Bruns et al. (2011) noted that publicly financed school systems' failure to deliver services effectively despite increased inputs through policies and programs. Teachers reported that professional development opportunities are limited. To strengthen teacher accountability and improve science learning outcomes, professional development programs must adopt a practical approach and provide opportunities for continued growth and access to quality preparation through training (not limited to it), workshops, seminars, conferences, dialogue sessions, and exposure visits. Teachers should be provided with effective incentives and rewards for their better performance based on periodic assessment and their students' learning outcomes. A school accountability framework needs to be developed that includes well-defined roles and responsibilities, monitoring, a feedback loop, communication channels, reporting, and supporting systems that effectively promote teachers' accountability.

Conclusion

Teachers' accountability is an essential component of an effective school system. Schools with higher levels of teachers' accountability tend to show higher science achievement. The existence of disparity in science achievement and accountability practices in schools is attributed to school management, teacher-related factors, students' own efforts, and their parents' education and socioeconomic status. Some constraints on the enactment of teacher accountability include resource constraints, limited access to technology, restricted teacher autonomy, insufficient prospects for capacity building, and poor school governance.

This study suggests changes to current practices to improve schools' academic abilities, highlighting the need to empower teachers and improve existing school practices. The study revealed that teachers' efforts, quality teaching-learning, personal ownership, use of regular monitoring and feedback loops, regular support for students, improved students' motivation and regular communication with stakeholders significantly advance students' academic performance, especially in science. Nepal's school system requires developing an accountability mechanism that fosters a culture where teachers are held accountable for their students' performance. Furthermore, teachers' accountability should not rest only on merit-based pay, but also requires supporting every teacher in their professional development- schools should provide training, mentorship and other professional development opportunities, as well as resources and every support they demand. School-parent collaboration, setting a collaborative working culture, is a way forward to achieve greater student achievement in science. In a nutshell, shifting paradigm from traditional teaching and learning in schools demands the establishment of congruence between accountability practices, school systemic reform and stakeholders fulfilling their roles and responsibilities. Strengthening accountability practices in Nepalese schools could enhance science achievement, and teachers' accountability may play an important role. The study underscores the need for schools to empower teachers through resources, institutional support, training, and the implementation of collaborative, functional accountability mechanisms to foster sustained improvements in student science achievement.

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Declaration of competing interest

The authors declare no conflicts of interest.

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