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Research Paper

Effect of Performance Assessment based Instruction on Attitude towards Science at the Middle School Stage

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ABSTRACT

The study investigated the impact of performance assessment-based instruction on attitude towards science of students at the middle school stage. This study follows mix methods research design. This study employed an explanatory sequential mixed methods design. For the quantitative analysis quasi experimental research design of non-equivalent pretest post-test control group design was used and for qualitative analysis focus group discussion was used. Class 8th students from one government school in the Bihar School Examination Board were selected as participants in the study. Intervention on performance assessment based instruction was given to the experimental group, and the traditional approach of instruction was followed for the control group for 45 days. The result revealed that the performance assessment based instruction positively changes the attitude of students towards science, while the result is supported by the statement of the focus group discussion. Also, the activity package on the performance assessment-based instruction fulfils the demand of modern classroom.

Keywords: *Performance assessment-based instruction, Attitude, Science, Middle school Stage*

Assessment strategies play a pivotal role in shaping students' educational experiences and perspectives, particularly within the dynamic and diverse landscape of Indian education. Traditional exam-centric systems have long been criticized for encouraging rote learning and contributing to exam-related stress. However, recent educational reforms like NEP 2020 in India advocate for more formative, competency-based, and continuous assessment methods. These approaches serve not only as tools for grading but also as mechanisms to motivate learners, enhance engagement, promote self-directed learning, and cultivate positive attitude towards education.

A growing body of research in India highlights that well-designed assessment strategies such as peer assessments, reflective assignments, and feedback can significantly improve learning outcomes. This is all achievable with effective classroom performance assessments. Performance assessment, assesses students through tasks that reveal their application of knowledge and skills in real-world contexts, has gained attention for its potential to improve both learning outcomes and student attitude towards science. Performance assessment

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involves evaluating students through tasks such as experiments, projects, investigations, presentations, and open-ended problem-solving activities. These methods help deepen understanding, strengthen knowledge retention, and foster constructive emotional responses to learning. Unlike traditional assessments that focus on recall and rote memorization, performance assessments require application, reasoning, and creativity (Darling-Hammond & Adamson, 2014). When assessments are perceived as fair, transparent, and supportive, they can boost students' confidence and motivation. Conversely, poorly designed assessments may increase stress and feelings of alienation.

Since the COVID-19 pandemic, the widespread integration of digital tools in Indian classrooms and the expansion of online and blended assessments have necessitated a re-evaluation of how assessments influence student behaviour and attitudes. At the primary school level, many students show a strong interest in science. However, this enthusiasm often declines as they transition to middle school (Potvin & Hasni, 2014a; Savelsbergh et al., 2016). To counteract this trend, educational innovations in instructional strategies and assessment practices are increasingly being used to sustain interest and foster positive attitudes toward science (Fortus, 2014). Attitude towards science is complex and multifaceted, encompassing emotions, beliefs, and values related to science as both a discipline and a way of understanding the world. These attitudes affect how individuals engage with scientific content, their involvement in scientific activities, and their views on the relevance of science in society. As Newhouse (1990) argues, attitudes are fundamental drivers of human behaviour, shaped by personal experiences and education. Osborne et al. (2003) further explain that attitudes are composed of various sub-constructs that collectively shape an individual's perspective on science.

In today's scientifically and technologically driven world, students' attitude towards science are critical. These attitudes not only influence educational engagement and reasoning ability but also affect students' future participation in STEM fields. Understanding and nurturing positive attitude towards science are, therefore, essential for educators and policymakers aiming to improve scientific literacy and foster long-term engagement with science.

A scientifically literate person tends to adopt a scientific worldview. A positive disposition toward science significantly correlates with enhanced academic performance across multiple disciplines. Therefore, it is the responsibility of educators and mentors to foster such attitudes, equipping students to thrive in a society that increasingly depends on scientific and technological literacy. Encouraging positive attitude towards science among young learners opens doors to diverse opportunities and essential skill development. Teachers play a crucial role in this process by designing learning experiences that inspire curiosity, creativity, and a favourable disposition towards science. Classrooms must become environments where creativity is nurtured and enthusiasm for science is actively encouraged. Hence this study seeks to know how performance assessment impacts students' attitude towards science at the middle school level, which is crucial, especially in shaping interest, engagement, and future participation.

REVIEWS OF THE STUDY

In India, NCERT (2019) highlight that traditional testing fosters anxiety and disengagement. Activity-based and performance assessments improve academic performance and attitudes in science. The NEP 2020 stresses competency-based assessments, which encourage conceptual understanding over rote memorization. Research by Bennett et al. (2007) and

OECD (2016) supports that assessments aligned with active learning enhance students' attitudes towards science. Black and Wiliam (2009) argue that formative and performance-based assessments promote autonomy and engagement. Fortus (2014) found that meaningful science tasks enhance interest and emotional involvement. Through seeing the lens of pedagogical strategy, literature remains largely descriptive or survey-based, with limited experimental interventions assessing the causal impact of pedagogical strategies on student attitudes (Rani & Reddy, 2016; Singh & Acharya, 2020). Savelsbergh et al. (2016) reported that innovative teaching methods improve students' attitudes toward science's relevance. Moreover, the few experimental studies conducted often lack rigorous control groups or are geographically constrained to urban centers, ignoring rural and under-resourced contexts (Sharma & Yadav, 2018). While Hong et. al. (2012) showed that performance-based learning increases motivation and self-efficacy, particularly in middle school. Studies indicate that attitudes towards science are influenced by experiential learning and relevant assessments, aligned with constructivist approaches. However, Gupta & Gupta (2021) reported that rubrics and performance assessments enhance engagement and reflection in Indian technical institutions, while Ismail et al. (2022) found formative assessments increase motivation across disciplines. Much research targets general or subject-specific metrics without isolating science attitude development. Prompiengchai et al. (2024) studied peer assessment in online high schools without evaluating its impact on science attitudes. Thomas (2023) and Kundu & Bej (2021) analysed systemic challenges in Indian education without controlled experimentation. Sarkar (2012) and Singh & Modi (2013) proposed integrating competency and attitude-based evaluations. Despite interest in learner-centered assessment models, a significant research gap exists regarding the impact of performance assessment-based instruction (PABI) on students' attitudes towards science in Indian schools. The unexplored area is vital because PABI can effectively incorporate formative, task-based evaluations into science pedagogy, enhancing engagement and positive perceptions.

Research questions

- Does performance assessment based instruction change the attitude of students towards science?
- What is the effect of performance assessment activities on the students' attitude towards science at the middle school level?

Objectives of the study

- To study the effect of performance assessment based instruction on attitude towards science at the middle school stage.
- To study the effect of performance assessment based instruction activities on the students' attitude towards science.

Hypothesis of the study

- H1- To study the effect of performance assessment based instruction on the attitude of students towards science, the following null hypothesis has been framed-
- H0- There is no significant effect of performance assessment based instruction on the attitude towards science of the students at the middle school stage.

Operational Definitions of the Terms used

- **Performance assessment-based Instruction-** Performance assessment-based instruction is an instructional strategy where assessment is integrated within

classroom instructional process. This approach integrates varied assessment activities designed to meet the requirements of each chapter.

- **Attitude towards Science-** Attitudes toward science encompass the feelings, beliefs, and values people hold about various aspects of science. This includes their perspectives on scientific work, school science, and the effects of science on society and scientists.
- **Middle School Stage-** Middle school stage includes students who study in grades 6 through 8, aged between 11 to 14. For the present study, students who are learning in grade 8 are taken as middle school students.

METHODOLOGY OF THE STUDY

The study aims to assess the effect of Performance Assessment based Instruction on the attitude of Middle Stage School Students towards Science. The study followed a mixed methods approach. In mixed methods, an explanatory sequential research design was followed. For the quantitative data non-equivalent Control Group pretest-posttest design of Quasi-experimental type was used to evaluate this effect. Two intact sections of class VIII at a government school under the Bihar School Examination Board were selected for the study, with one assigned as the experimental group and the other as the control group. Focus group discussions were conducted to assess the effectiveness of the performance assessment activities in changing the attitude of students towards science.

Participants of the study-

"Kanya Madhya Vidyalaya, Amla Tola" school in Patna district of Bihar school examination board, was selected conveniently for the study. Two intact sections of class VIII of the same school was chosen, and all the students of these two sections were considered as a sample for the study. For the focus group discussion, 15 students from the experimental group have been selected randomly. The Details of the sample are given below-

Table 1. Details of Sample

School Name	Group	Participants
Kanya Madhya Vidyalaya Amla Tola, Chitkohara Bazra	Experimental group (PABI)	38
	Control Group (TABI)	43

Tools used in the study-

An adapted version of the Attitude towards Science Inventory of Tai et. al. (2022) was used to measure the students' attitude towards science. This instrument incorporates five sub-scales: "perception of the teacher, anxiety towards science, value of science to society, self-confidence in science, and the desire to do science". A five-point Likert scale was utilized for instrument scoring, with responses ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), including 2 (Disagree), 3 (Neutral), and 4 (Agree).

Procedure of the study-

At the initial stage, an attitude towards science pretest was given to two sections of the 8th grade. Following this, classes were randomly assigned to either the experimental or control group. The experimental group engaged in performance assessment-based teaching and learning activities for 45 days, while the control group followed traditional teaching methods, both using the same curriculum materials. To minimize variability in teaching, a single teacher instructed all students, but only those in the experimental group took part in

the performance assessment-based activities. After the 45 days, a post-test, which was again an attitude towards science test was conducted for both groups.

Instructional content and performance assessment activities

Instructional materials were consistent across both experimental and control groups. The only variation concerned the application and use of performance assessment in pedagogical practices. This performance assessment prioritized execution and process, considering both how the task was done and the result achieved. Stars and the solar system from physics, Combustion and flame from chemistry and Reproduction in animals from biology chapter was taken from class VIII science. Teaching point of each chapter was introduced in the experimental class through several performance assessment activities such as chart preparation, experimentation, poster, model preparation, story writing, diagram, etc, that include their active participation and self-evaluation of their own task. Self- assessment, peer assessment and teacher assessment with rubrics were used for the assessment purpose.

RESULT AND DISCUSSION

Study of Normality

Skewness and kurtosis is calculated to know the distribution of the data of pretest and post test score of experimental and control group. The skewness of pretest score of experimental and control group is -0.289 and -0.190 while in post-test the skewness of experimental group and control group is -0.370 and -0.086 respectively. In both cases distribution is negatively skewed. Moreover, from the pretest (0.463) and post-test (-0.605) kurtosis value of experimental group, it assumed that distribution is platykurtic. Along with this, kurtosis value of control group in pretest (-0.729) and post-test (1.547) states that the distribution is platykurtic. Since this value not clearly stated that the distribution is either normal or not. Hence for the conformity of normality Shapiro wilk test has been administered. In this test the p value (0.863)>0.05, clears that the data is normality distributed with statistics value 0.991.

Since the data is satisfied the assumption of parametric test. Hence parametric statistics has been used for further analysis. To know the significant difference between the pretest scores of experimental and control group and post test scores of experimental and control groups in attitude toward science independent sample ‘t’ test is used.

Table 3. Summary of independent ‘t’ test of attitude towards science

Groups	Tests	N	X	SD	df	t-value	p-value	Remarks
Control (TAI)	Pre test	43	51.88	9.73	79	0.658	0.513	p>0.05
Experimental (PABI)		38	53.21	8.42				
Control (TAI)	Post test	43	61.40	6.42	79	2.081	0.040	p<0.05
Experimental (PABI)		38	64.82	8.33				

Note- t value for df (79) at 0.05 level- 1.99 & at 0.01 level- 2.64

The pretest scores showed no significant difference (t = 0.658, p = 0.513>0.05) in students' attitude towards science between the control and experimental groups with mean difference of 1.33. However, the posttest scores revealed a significant difference (t = 2.081, p = 0.040

< 0.05) between the groups (mean difference: 3.42), favoring the experimental group. Therefore, the null hypothesis that performance assessment-based instruction has no significant effect on students' attitude towards science is rejected. From the experimental group result it is clear that performance assessment-based instruction is more effective than traditional assessment-based instruction in improving students' attitude towards science.

Testing of H0- There is no significant effect of performance assessment-based instruction on the attitude towards science at middle school level.

In the present study quasi experimental research method was conducted where two intact classrooms were used for the experimental purpose. Hence, ANCOVA analysis was done to get the true information about the differences between the experimental group and the control group in attitude towards science. Before proceeding further, Levens test is calculated for knowing the variability among the data. In Levens test the F value of 0.112 with df (1,79) and p (0.738)>0.05 showed that it satisfied the homogeneity of variance test. The result of ANCOVA has been presented in table 2.

Table 2 ANCOVA analysis on attitude towards science

	Sum of Squares	**df**	**Mean Squares**	**F**	**P-value**	**Remarks**
Instructional strategy (performance assessment-based instruction)	151.058	1	151.058	4.50	0.037	P<.0.05 (S)
Attitude toward science SS between	1686.900	1	1686.900	50.27	0.010	P=0.01
Error SS within	2167.090	78	33.552			
Corrected total	4540.00	80				

F-ratio at df (1,78) =3.96 at 0.05 level & 6.96 at 0.01 level

Table 2 shows that performance assessments positively impact attitude towards science. Even after controlling for pretest scores, instructional strategy significantly improved attitudes F (1,78) = 4.50, p = 0.037 < 0.05). This F-ratio exceeds the critical value of 3.96 at the .05 level df (1,78). Therefore, the null hypothesis that performance assessment-based instruction has no significant effect on middle school students' attitudes towards science was rejected. Covariance analysis, adjusting for pretest scores, revealed a significant difference between the control and experimental groups' posttest scores. This suggests that performance assessment-based instruction and traditional methods have different effects on middle school students' attitude towards science. This result is in the line with the study of Hj Abdullah et.al (2012), Episona (2015), Alkhateeb (2018), Maier et. al., (2020), Aladini et.al, (2024) that emphasized using performance assessment strategy in the classroom improve the emotions and perception towards the subjects. It also improved the learning outcome and other cognitive factors as well. This is due to the interactive engagement of activity among the students. When the students are exposed to various form of hands-on activities like making model, observation, experimentation, story writing, puzzle solution, open ended question presentation etc, and are provided a chance to improve themselves by the feedback of teacher and a platform to evaluate themselves then it ultimately affects the learning interest and attitude of students towards the subject.

Objective 2: To study the effect of Performance assessment-based instruction activity package on the students attitude

To achieve this objective focus group discussions were conducted on 15 students from the experimental group. The discussion was conducted after the post test was taken from both the groups. Several questions were discussed with the team of 15 students and provide a platform to speak up about performance assessment-based instruction, instructional strategy and activities without any hesitation.
The questions are as follows-

- How do science teachers support you while performing performance assessment activities?
- Do you feel pressure while doing tasks in science assessment in the class?
- Does learning through activities in science help in applying the concepts in real life?
- How do you experience to do performance assessment activities in science of your own?

The 15 students are coded from S1, S2, S3… up to S15. The responses of the students for each question were thematically analyzed and discussed under the themes of instructional utility, perceived relevance, students' engagement and assessment experiences.

Instructional Utility- In the response of the first question student S2, S5 mentioned that *Teacher ne har chapter ko alag alag tarike se padhaye aur hume chance diya ki unke demonstration krne ke baad students ushi practical work ko karke dekhe* (Teacher used a variety of methods to teach each chapter, and let us try the practical work ourselves after demonstrating it). Students S1, S9 and S14 given agreement with this response. While S3, S6, remarked that "*kabhi kabhi activity me material change ho jate the toh us activity ke through ek se jyada perspective ko janne ka mauka milta tha aur in sabhi me teachers ne hume bhut guide kiya jahan hum galt hote the" (Sometimes* the activity materials changed, which let us see things from different angles. Our teachers were really helpful in pointing out where we went wrong*)*. In the same light S7 and S13 also mentioned that "*science me khud se karkke dekhen ke baad phle jo concept nhi samajh aata tha wo ab aasani se aata hai*"(I found that after doing science experiments myself, the concepts that I could not understand before became much easier). Also, S4, S12 & S13 stated that "*Kuch task me like presentation, poster bnana, debate etc me suru me particpate nhi karate the pr humare teacher ne hume bhut hi jyada encourage aur support kiye aur class ka environment friendly bnaya jisse science me humara interest badha"* (Initially we were not interested on the performances like presentations, posters, and debates, but our teacher's encouragement, support, and the friendly classroom atmosphere boosted our interest in science*)".* Students S5, S10 and S11 also gave their response in agreement with the above statements. Now, it is clear from the above statement that when using performance assessment-based instructional activities in the classroom, the teacher acts as a role model, a guide who supports and motivates students in their learning to achieve clarity on any concept.

Perceived Relevance- In the response of the third question, almost all students stated the same that "*Jo bhi activity karke humne class me sikha hai unka upyog humare jeevan me bhut hi jyada hai chahe wo physics, chemistry ya biology ki baat kare"* (The activities we did in the class are incredibly useful in our lives, whether it is physics, chemistry, or biology). Besides stating its importance students S1, S6, and S12 talked about an activity

done in combustion and flame chapter that "*jab humne wood, kerosene aur LPG ke jalane ka observation karane aur yah dekhane ke lie kaha ki kaun adhik pradooshak utpann karata hai, to isase air pollution karane waale elements ko samajhane mein help milee aur saathahee fuel ke safety upayog ko seekhane mein bhee madad milee jo har insaan ko healthy aur safe rakhne ke liye jruri hain*" (Observing how wood, kerosene, and LPG burned, and which produced the most pollution, helped students understand what causes air pollution and how to use fuel safely which is necessary to keep people healthy and safe). Many students provide several examples that directly link to our daily life and change the myth of society. Students S4 and S2 responded that "*Ladies ke reproductive system par kaam karate samay, kaee facts saamane aate hain jo menstruation ke baare mein galat dhaaranaon ko badal dete hain. ye dhaaranaen aksar dar, sharm aur guilt paida karatee hain. Isake saath hee, yah samajhana bhee zarooree hai ki maasik dharm vikaas ke lie kitana mahatvapoorn hai aur personal hygiene kitanee aavashyak hai*"(Understanding the female reproductive system dispels menstruation myths, replacing unnecessary fear, shame, and guilt with knowledge of its importance in human development and personal hygiene). After this, all girls agreed with the above responses. Hence, student responses clearly indicate that this approach successfully helps students grasp how classroom activity connect to their personal lives and the broader societal context.

Students' engagement- In the response of the fourth question, students S2, S15 mentioned that "Science *me bahut sari chije activity ke dwara smjh me aati hai, humesha teacher ne usse karke dikhaya hai*" (In science, many concepts become clear through hands-on activities, which our teacher has always shown us). S3, S9, and S15 likewise concurred with the responses provided. Apart from this students S1, S7, S13 and S14 mentioned that "*science class teacher ke dikhane aur batane ke baad jab hume pehli baar hur topic ko khud se karne ka chance mila to hmne bhut alag alag angle se chijon ko smjha jaise ki female ke reproductive system me fallopian tube ka kya importance hai r kaise kaam krta hai saath hi Purnima r amawsya kaise r kyu hota hai*" (When we finally got to explore the topics on our own after our science teacher's lesson, we looked at them from many different perspectives. For example, we investigated the role and function of the fallopian tubes in the female reproductive system, and also researched the causes and mechanics of full moons and new moons). Students S8, S10, and S11 further substantiated the aforementioned claims through illustrative examples. Moreover, student S8 and S15 replied that "*Mujhe bhut hi maja aata tha practical work karne me aur bhut confident feel hota hai aur phle se jyada acche se kisi v concept ko samajh sakte hain jisse interest develop hua hai"*(I really enjoyed doing practical work and felt very confident and could understand any concept better than before as I developed an interest in it). The statements made by the preceding students are also affirmed by S1 and S2. Student feedback confirms the high effectiveness of the intervention's activity package, showing improvements in understanding, engagement, retention of scientific concepts, and mastery of complex topics, with concomitant gains in attitude, interest, motivation, and self-confidence.

Assessment experiences- In the response to the second question, students S2, S5, and S13 stated that "*pehli baar jab activity karne ke baad humse puccha gya ki tumhe kahan sudhar krne ki jrurt hai r kahan bahut mistake hai tab bahut nervous lag rha tha* (The first time after doing an activity, when I was asked where I need to improve and where I made mistakes, I felt very nervous*).* In agreement with this response S6, S7, and S11also added that *uske baad phir teacher ne bhi usi activity par jab hume feedback diya ki kaha accha hai, aur kahan galt hai tab hume pata chla ki ye humara assessment ho raha hai*" After that,

when the teacher gave me feedback on the same activity, asking what was good and what was wrong, I realised that this is our assessment). In the light of this students S3, S13 and S12, replied that "*Jo bhi activity ya toh prayog, kahani lekhan, poster, model, paheli, debate, ya presentation, suru me hume dur lgta tha jakr sbke samne bolne me pr dheere dheer accha lgne lga, sudhar bhi hua aur bhut kuch banae bhi aaya*" (Whatever the activity was, be it experiment, story writing, poster, model, puzzle, debate or presentation, initially I used to feel distant but gradually I started feeling good in speaking in front of everyone, I improved and learnt a lot too). The aforementioned response also received agreement from S7, S10, and S11. While students S12 and S15 mentioned that "*Pehli baar activity ke through assessment ke time bahut nervous hua r bekaar lag rha tha, lekin uske baad koi pressure feel nhi hua aur bhut interesting lag rha tha phir teacher ka feedback hume jo v glti ho rhi hai usme kahan sudhar krna hai ye bta rhi thi jisse science me sudhar kar rha tha*" (I was really nervous and felt terrible during my first activity-based assessment, but afterwards, I felt no pressure and found it really interesting. The teacher's feedback helped me identify my mistakes and how to improve, which really helped me in improving my learning in science). Students S3, S8, and S13 indicated their assent to the previous response. Now, it is clear from the above statements that at first, the students felt stressed about the assessment, but as they got used to the process, their stress levels went down, and they became more relaxed, motivated, and saw it as a chance to learn. It has now become clear through observation and analysis that the assessment components generated a demonstrably positive response from the students.

CONCLUSION

This study conducts a comparative analysis of two learning environments: the traditional approach to instruction and performance assessment-based instruction. The findings provide valuable insights into the impacts of performance assessment-based instruction on critical dimensions of students' educational experiences, such as their attitude towards science. The results reveal a significant difference between traditional teaching methods and performance assessment-based teaching methods, highlighting the unique advantages of performance assessment-based instruction. Notably, performance assessment-based instruction proves to be instrumental in enhancing students' attitude towards science. Furthermore, this method of instruction offers flexibility and autonomy to students. The activities utilized for instruction and assessment create a platform for student involvement, allowing them the opportunity to rectify their mistakes, identify weaknesses, and take steps to improve themselves. This approach not only enhances one's attitude, but also cultivates self-confidence, ignites motivation, and effectively overcomes the apprehension associated with speaking in front of others. Ultimately, this approach fosters cognitive development and provides emotional stability among students.

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Conflict of Interest

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