



TEACHING PRACTICES OF GRADE 8 SCIENCE TEACHERS EMBEDDED WITH AI-DRIVEN ADAPTIVE LEARNING SYSTEM IN SCIENCE INSTRUCTION

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ABSTRACT

Artificial intelligence (AI) offers opportunities to personalize science instruction, yet evidence regarding teachers' AI-supported practices and learners' cognitive engagement remains limited. This study examined Grade 8 Science teachers' practices embedded with AI-driven adaptive learning systems at Bongabon National High School, Nueva Ecija, during school year 2026–2027. Specifically, it described teachers' profiles and practices across planning and preparation, classroom environment, instruction, and professional responsibilities, and investigated relationships and differences in respondents' perceptions. A descriptive survey design with quasi-experimental designation, involved six Grade 8 Science teachers and 499 students. Teacher respondents were covered through complete enumeration, while student respondents were selected through simple random sampling. Questionnaires provided data analyzed using frequencies, percentages, weighted means, t-tests, and Spearman's rho. Findings indicated that AI-embedded teaching practices were "Always Practiced," with an overall grand weighted mean of 3.60. Classroom environment obtained the highest combined domain mean (3.64), followed by instruction (3.62), planning and preparation (3.59), and professional responsibilities (3.55). Teachers' educational attainment showed significant negative relationships with planning and preparation ($\rho = -0.892$) and classroom environment ($\rho = -0.874$), whereas other profile variables showed no significant relationships. Teachers' and learners' perceptions did not differ significantly across domains. The study concluded that AI-supported teaching practices were consistently reported and recommended targeted professional development and activities to strengthen comparatively less-practiced areas. These findings may guide context-responsive integration of adaptive learning tools in junior high school Science instruction while supporting reflective teaching practice and student engagement. This supports responsible implementation.

KEYWORDS: AI-Driven Adaptive Learning Systems; Cognitive Engagement; Grade 8 Science; Teaching Practices; Descriptive Survey; Educational Technology

1. INTRODUCTION

Artificial intelligence is changing the landscape of professional and academic education and is rapidly reshaping the way knowledge is transmitted, understood, and assessed. New advances in educational technologies present fresh opportunities for both the teachers and students for effective learning to happen. Away from the conventional "one-size-fits-all" educational model, the vision of education now is advancement of every student at their own pace and in their own style (Ilhan Alyay et.al 2026).

Most current research focuses on students' perceptions of AI tools or the results of using AI tools to support learning, but does not isolate how the teacher is a mediating variable in AI-supported teaching (Qureshi et al., 2025). The effect of AI-supported teaching, a conscious pedagogical action of a teacher, on student engagement and learning outcomes as specific processes has not been sufficiently studied. In addition, it is rare to have both teacher and student perspectives in the same educational setting documented at the same time, reducing the ecological validity of the findings available (Fahreni et al., 2024; Obidovna, 2024).

As Science education aims to develop scientific literacy among students that will prepare them to be informed and participative citizens who are able to make judgments and decisions regarding applications of scientific knowledge that may have environmental impacts will address the issues and

concern through integration of AI Adaptive Learning System in teaching Science.

The Department of Education (DepEd) recognizes that the success of any education system greatly relies on the competence of its teachers. Hence, one of the primary issues the Department aims to address through its comprehensive implementation of the K to 12 Basic Education Program is the need for highly competent teachers in public elementary and secondary schools. (DepEd Order No.7,s. 2015) Their education and qualification can therefore play a decisive role in optimizing educational processes.

According to Friedman (2005), "To survive in a new, globally competitive world, today's children will need creativity, problem-solving abilities, and a passion for learning, a dedicated work ethic and lifelong learning opportunities. Students can develop these abilities through instruction based on Best Practice teaching strategies."

The research uses the four teaching domains of the Danielson Framework for Teaching (2014). This framework is designed to support students' achievement and professional best-practices through the domains of Planning and Preparation, Classroom Environment, Instruction, Professional Responsibilities.

In today's shift is largely driven by the rise of adaptive learning systems, which use technology to tailor educational experiences to individual learners' needs. Artificial intelligence



(AI) is at the forefront of this transformation. Adaptive learning systems use AI algorithms to analyze students' data in real-time, providing a customized learning experience that caters to different learning styles, paces, and levels of understanding. These systems identify a student's strengths and weaknesses, adjusting content delivery and instructional strategies accordingly. This personalized approach enhances comprehension, retention, and engagement, fostering a more interactive and motivating learning environment (Chen, Ryan, & Wang, 2022).

Furthermore, AI-driven adaptive learning systems are a powerful solution for addressing the diverse needs of learners in the digital age. These systems are designed to create personalized educational experiences, enhancing engagement and improving outcomes. (Luckin et al., 2016; Zawacki-Richter et al., 2019). AI technologies used in adaptive learning include machine learning algorithms, natural language processing (NLP), learning analytics, and personalized content delivery (Vaithianathan, Mahesh, Shunye, & Shiv, 2024; Olusegun, Flypaper, Oluwaseyi, & Brightwood, 2024). Machine learning algorithms predict students' performance, adapt content difficulty, and recommend resources based on individual learning patterns. Natural language processing allows adaptive learning systems to understand and respond to students' inquiries in real time, providing contextualized feedback and support. Learning analytics evaluates how students interact with content, identifying areas for improvement and recommending adjustments. Personalized educational experiences are at the core of AI-driven adaptive learning systems (Younus, 2024).

2. OBJECTIVES

The study aimed to describe Grade 8 Science teachers' AI-supported teaching practices and their relationship to students' cognitive engagement, as framed by the manuscript. Specifically, it sought to: (a) describe the teachers' profiles; (b) determine perceived practices in four teaching domains; (c) examine the relationship between teacher profile and reported practices; (d) compare teachers' and learners' perceptions; and (e) propose activities to sustain effective practices.

3. METHODOLOGY

A descriptive-survey approach with a quasi-experimental design was used. The evidence presented consists principally of questionnaire-based descriptive statistics and comparison tests.

The main instrument was a two-part questionnaire. Part I gathered teacher-profile information, including age, sex, civil status, education, seminar attendance, teaching experience, and position. Part II collected Likert-scale ratings of the four teaching domains from teachers and learners. The teaching-practice items were adapted from the Danielson framework, with additional professional-responsibility material informed by the Code of Ethics for Professional Teachers. The draft questionnaire were reviewed and asked school permission before administration.

4. SAMPLING DESIGN

All six (6) Grade 8 Science teachers were included using complete enumeration while the learners were selected through simple random sampling.

Table 1. Reported respondents

Respondent Group	Reported Number	Sampling Description
Grade 8 Science teachers	6	Complete enumeration
Grade 8 learners	499	Simple random sampling
Total	505	

Questionnaires were personally administered and retrieved by the researcher following permission from relevant school authorities. Responses were collated and coded for statistical processing.

5. STATISTICAL DESIGN

Frequency and percentage described teacher profiles. Weighted means summarized Likert-scale ratings, interpreted using four-point scale: 3.25–4.00 = Always Practiced; 2.50–3.24 = Often Practiced; 1.75–2.49 = Seldom Practiced; and 1.00–1.74 = Never Practiced. Spearman's rho was used for

teacher-profile associations with domain ratings. A t-test compared teacher and learner perceptions; decisions were interpreted at $\alpha = .05$. Microsoft Excel and SPSS were identified as data-processing tools.

6. GEOGRAPHICAL AREA

The research locale was Bongabon National High School, Bongabon, Nueva Ecija, Philippines, during school year 2026–2027. The institutional scope was limited to the school's Grade 8 Science teachers and learners.

Figure 1. Study setting and respondent pathway

GEOGRAPHICAL SETTING	SCHOOL-BASED PARTICIPANTS	DATA COLLECTION
Bongabon, Nueva Ecija Philippines	6 Grade 8 Science teachers 499 reported learners	Two-part questionnaire Profile + domain ratings

7. RESULTS

7.1 Teacher Profile

The six (6) teacher respondents were female and married. Three were college graduates, two had MAEd units,

and one had completed an MAEd degree. Three were Teacher III, two Teacher I, and one Master Teacher I. Teaching experience was distributed across 1–5 years (2), 6–10 years (2), 11–15 years (1), and 16–20 years (1).



7.2 Summary of the Perceived Teaching Practices Embedded with AI-Driven Learning System of Grade 8 Science Teachers

Domain	Teachers	Learners	Combined	Interpretation
Planning and Preparation	3.63	3.56	3.59	Always Practiced
Classroom Environment	3.70	3.57	3.64	Always Practiced
Instruction	3.60	3.63	3.62	Always Practiced
Professional Responsibilities	3.52	3.59	3.55	Always Practiced
Overall grand mean	3.61	3.59	3.60	Always Practiced

All four domains were classified as “Always Practiced.” Classroom Environment had the highest combined mean (3.64), followed by Instruction (3.62), Planning and Preparation (3.59), and Professional Responsibilities (3.55). This ordering identifies areas of relative strength and lower reported frequency within an overall high-scoring pattern.

It clearly shows that the responses from the teachers and learners from all the domains presented by Charlotte Danielson (Domain 1:Planning and Preparation, Domain 2: Classroom Environment, Domain 3: Instruction, Domain 4: Professional Responsibilities) on his Framework For Teaching were consistent. The data revealed that the teaching practices presented by the researcher in her questionnaire were what the teacher actually does in the classroom all the time.

7.3 Relationship between the profile of the teacher and their teaching practices embedded with AI-Driven Learning System of Grade 8 teachers in Science

Only the educational attainment of the teachers has correlation coefficients that resulted to less than 0.05 level of

significance, namely Domain 1:Planning and Preparation with correlation coefficient of -0.892 and Domain 2:Classroom Environment with correlation coefficient of - 0.874. The rest of the profile variables have correlation coefficients that resulted to insignificant level of relationship. Considering the least number of variables with significant level, the researcher is compelled not to reject the hypothesis of the study. Therefore, there is no significant relationship between the profile of the teachers and their practices as grade 8 teachers in science.

According to James (2008), advanced degrees, particularly master's degrees, have a positive effect on high school Mathematics and Science teacher teaching practices.

However, according to Danhui Zhang (2008), teachers with advanced degrees are more likely to have opportunities to get promoted and take on administrative responsibilities, especially if they have worked for a long time in the schools. Therefore, they may need to spend more time on those organizational duties and put less time and effort into their teaching.

7.4 Summary of the t-test Analyses Made Between the Teachers and their Students on the Perceived Practices Embedded with AI-Driven Adaptive Learning System in Teaching Grade 8 Science

Domain	t statistic	p (two-tailed)	Decision at .05
Planning and Preparation	1.09	.28	Not significant
Classroom Environment	1.81	.08	Not significant
Instruction	-0.94	.35	Not significant
Professional Responsibilities	-0.92	.30	Not significant

All four teacher–learner differences were reported as nonsignificant at $\alpha = .05$. Accordingly, the two respondent groups did not show statistically detectable differences in their ratings of the four teaching domains in the reported analyses.9. Tables, Implications, and Suggestions

8. SUMMARY OF FINDINGS

1. Profile of the Teacher-Respondents

a. Age- Of the six teachers, 16.7% or one each of the teacher-respondents belonged to bracket 20-25 and 26-30 years while two each or 33.33% belonged to ages 31-35 and 41-45.

b. Sex-All of the respondents (6) were females.

c. Civil Status- Zero or 0% of the teacher-respondents were single while six or 100% were married.

d. Highest Educational Attainment- The total of three or 50.0% of the teacher-respondents finished college while two or 33.3% were college graduates with MAEd units and one or 16.7% was a MAEd graduate.

e. Seminars Attended- In terms of seminars attended, respondent number 2 had the most frequent number of seminars attended from 2024- 2026 with three or 50.0% while respondents number 1, 4 and 5 attended only one or 16.7% seminar from 2024- 2026.

f. Years in Teaching- Two or 33.3% belonged to bracket 1-5 and 6-10 years in teaching respectively while one each or 16.7% belonged to bracket 11-15 and 16-20 years in service.

g. Teaching Position- Three or 50% of the teacher-respondents were Teacher-III while two or 33.3% of the teacher-respondents were Teacher-I and only one or 16.7% of the teacher-respondents was Master Teacher-I.

2. Perceived Teaching Practice Embedded with AI-Driven Adaptive Learning System of Grade 8 Science Teachers

The responses from the learners show that in Domain 1: Planning and Preparation, the weighted mean was 3.56 with verbal description of “Always Practiced” while Domain 2: Classroom Environment the weighted mean was 3.57 with



verbal description of “Always Practiced” then, Domain 3: Instruction the weighted mean was 3.63 with verbal description of “Always Practiced” and Domain 4: Professional Responsibilities the weighted mean was 3.59 with verbal description of “Always Practiced”. The grand weighted mean was 3.59 described as “Always Practiced”.

The overall weighted mean in Domain 1: Planning and Preparation was 3.59 described as “Always Practiced” while Domain 2: Classroom Environment was 3.64 described as “Always Practiced” also then, Domain 3: Instruction was 3.62 described as “Always Practiced” lastly Domain 4: Professional Responsibilities was 3.55 described as “Always Practiced”. It got an overall grand weighted mean of 3.60 described as “Always Practiced”.

3. Relationship between the profile of the teacher and their practices embedded with AI-Driven Adaptive Learning System as Grade 8 teachers in Science

Only the educational attainment of the teachers had correlation coefficients that resulted to less than 0.05 level of significance, namely; Domain 1: Planning and Preparation with correlation coefficient of -0.892 and Domain 2: Classroom Environment with correlation coefficient of -0.874. The rest of the profile variables have correlation coefficients that resulted to insignificant level of relationship. Considering the least number of variables with significant level, the researcher is compelled not to reject the hypothesis of the study. Therefore, there is no significant relationship between the profile of the teachers and their practices embedded with AI-Driven Learning System.

4. Difference between the Perceptions of Teachers and Learners on the Teaching Practices Embedded with AI-Driven Adaptive Learning System of Teachers in Teaching Grade 8 Science

The summary of the t-test analyses made between the teachers and their students on the perceived practices embedded with AI-driven adaptive learning system in teaching Grade 8 Science. The computed t values of the analyses were lower than the critical values in all domains. Hence, the hypothesis is not rejected. Thus, there is no significant difference between the perceptions of the teachers and their students.

9. CONCLUSIONS

Based on the findings of the study, the researcher arrived at the following conclusions:

1. Majority of the respondents were in the age bracket of 31-35 and 41-45 years old, all females, mostly married, college graduates and continued attending seminars, with years of experience within 1-5 and 6-10 years and mostly Teacher III in teaching position.

2. The responses from the teachers with regards to their teaching practices in Science showed that Domain 2: Classroom Environment got the highest grand weighted mean followed by Domain 1: Planning and Preparation then, Domain 3: Instruction and Domain 4: Professional Responsibilities got the lowest grand weighted mean.

With regards to the responses from the learners, Domain 3: Instruction got the highest grand weighted mean followed by Domain 4: Professional Responsibilities then,

Domain 2: Classroom Environment and Domain 1: Planning and Preparation Domain 1: Planning and Preparation.

Domain 2: Classroom Environment got the highest grand weighted mean from the responses from both the teachers and learners, followed by Domain 3: Instruction then, Domain 1: Planning and Preparation and Domain 4: Professional Responsibilities got the lowest grand weighted mean.

3. Only Highest Educational Attainment was the profile variable that was significantly related to their practices as Grade 8 teachers in Science. No significant relationship was noted between age, sex, civil status, seminars attended, years in teaching and position.

4. There is no significant difference between the perceptions of the teachers and their students on the teaching practices embedded with AI-Driven Learning System of Grade 8 teacher in Science.

5. Proposed activities were developed in order to enhance teaching practices least used or employed.

RECOMMENDATION

The following are recommended by the researcher:

1. Teachers may . . .

a. increase students' interest towards their studies by devising different creative and innovative ways of facilitating education;

b. include more specific integrated science process skills into oral and practical tests for the learners to develop and enhance their scientific skills;

c. pursue their post graduate studies such as Post Graduate Diploma in Education, Master's and Doctoral degrees in Education. This will help to improve teachers' quality of teaching and consequently improve the performance of students and ultimately, the quality of teacher education in the Philippines;

d. participate in pedagogically-oriented and content-oriented professional development activities to improve the quality of their teaching and consequently the performance of their students in tests and examinations; and

e. constantly seek to update their knowledge and skills through workshops, seminars and conferences. This will keep them abstract of the current trends in Science teaching.

2. Students may ...

a. develop good study habits to build a strong intellectual foundation with the help of their parents and teachers; and

b. apply different strategies in learning facilitated by the teacher in order to aid the slow learners, e.g buddy system or peer tutoring.

3. Parents' may ..

a. monitor their children's academic standing through constant interaction with the teachers regarding different activities in their science subject specifically during school visitation; and

b. provide different science materials at home as a source of scientific information.

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