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Exploring Elementary Teachers' Pedagogy in Teaching Science for Upper Standard: A Case Study

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Abstract: *The fundamental goal of this research is to look into the pedagogical practices used by elementary teachers when teaching science for higher levels. The study aims to better comprehend these educators' experiences with scientific instruction. The study, conducted within the context of a qualitative inquiry, focuses on primary instructors who teach science to upper-grade students. Interviews with 6 Science instructors were performed using a case study technique, with specific criteria based on their knowledge and experience. The semi-structured interviews sought to explore the teachers' experiences, challenges encountered in delivering science education to upper standards, and the strategies employed to address these challenges. A total of 6 respondents are now active primary school teachers with a focus on science instruction at the upper grade levels. The interview material was transcribed, coded, and categorised to discover reoccurring themes. The study's findings provide insights into educational tactics and approaches to improving science subjects for higher standards. Key themes identified include, the teachers' pedagogy, the key factors in shaping students' Interest in learning Science, and the best practices in teaching Science.*

Keywords: Elementary Teachers, Pedagogical Practices, Science Subject, Upper Standards, Teaching Strategies

1. Introduction

Pedagogical science may be linked back to prehistoric Egypt, Mali, Greece, Rome, and other early civilizations, with educational activities in some of these societies laying the framework for modern pedagogy. Pedagogical science is often understood to be the study of different approaches to learning that explain how people acquire and use information; nevertheless, this discipline also examines the primary parties that influence the method of delivering instruction and acquiring knowledge. To distinguish it from the study of teaching science subjects, pedagogical science can be referred to as methodology or educational science. Teaching is a two-part process: the educator, who is the message carrier, and the student, who is the communication recipient; the two work together to attain the educational goals that have been established. The teacher provides instructional content to the learner and then assesses how well the information was received, for example, by soliciting feedback from the learner. Scientists such as (Kirsi Tirri & Auli, 2020) Toom believe that an effective educational system should focus on the learner's overall development rather than just the domain of cognition. Focus on few kinds hands-on activities such as *Scientific Experiments and Demonstration, Model Building, Outdoor Exploration and Data Collection, Interactive Group Projects, Inquiry- Based Activities, Stem Challenges, Manipulative Tools, and Role- Playing and*

Simulations would be great to influence students' interest and comprehension in science. This kind of practice is significant because it converts a person into a lifelong learner, helping him to realise his greatest potential. Pedagogy has been characterised in a variety of ways throughout history, including art science, the profession of teaching, and the techniques and methods of teaching, particularly as a scientific field or theoretical notion. The primary purpose of pedagogical is to make a difference to the overall development of an individual and society via the use of a variety of scientific methodologies that aid the learning process. Pedagogical science, like the other four branches of study, is regulated by a set of standards that dictate how the field of study functions in order to achieve educational goals. This study aims to examine and evaluate the pedagogical approaches used by elementary science teachers to instruct upper-level students, with a particular emphasis on recognising key factors affecting students' interest in science and discovering efficient methods for effective science instruction.

Background of the study

In the context of Malaysian elementary education, the purpose of this study is to investigate teachers' methodology in science instruction for upper levels that increase the frequency of teaching and learning activities, as well as the consequent impact on students' science interests. Elementary science teachers have a critical role in shaping pupils' fundamental comprehension and curiosity about the scientific realm. The range of instructional approaches used by teachers becomes especially important when tackling higher requirements. The different talents of each primary pupil provide a demanding teaching and learning surroundings, necessitating a thorough examination of instructional approaches. Pedagogy basically refers to how teachers teach and students learn. It encompasses all of the tools and strategies educators use to help pupils comprehend and recall information. It is about providing a positive learning atmosphere, tailoring teaching approaches to individual pupils, and assisting students in developing crucial skills such as problem solving and analytical thinking. Essentially, pedagogy encompasses everything instructors do to ensure that pupils learn effectively. In the last few years, there has been a greater emphasis on the value of the science curriculum in primary schools, particularly at the upper levels. Learning about science at this level not only imparts vital knowledge but also helps students develop skills in critical thinking, problem-solving ability, and scientific literacy. A variety of things influence students' learning. Teachers and instruction have the biggest impact on what, how, and what exactly kids learn within the boundaries of schools. Many aspects of scientific instruction and student learning are influenced by two crucial instructor factors: pedagogy and attitude. Elementary school instructors play a critical role in influencing their views and opinions of science, and they also influence their academic performance in the subject. The ideas and practices that teacher have are critical to understanding and enhancing educational processes. In the current day, teacher preparation is a crucial prerequisite and component of all educational activities, including creating a supportive learning environment, developing and implementing curricula, and conducting assessments (Hafeez, 2021). A teacher with training and skill is better able to instruct students and successfully use a variety of teaching techniques (Saira et al., 2021). Students earn better academic performance and show greater enthusiasm when teachers use a variety of teaching approaches and tactics based on their acquired skills. These attitudes are critical for educating the new Generation Z, a generation that outperforms classical, traditional teaching-learning methodologies. Learning the new millennials age necessitates teachers exploring numerous approaches to comprehending this "connected" age Z. However, teaching science at higher levels brings distinct obstacles resulting from the rising complexity of scientific concepts plus the necessity for increasingly advanced pedagogical approaches. Historically, elementary science curriculum has been marked by repetition, textbook-based learning, and few hands-on opportunities. However, there is a rising acknowledgment of the need for creative and student-

centred methods to science education, particularly at the upper levels. Effective pedagogy in such an environment necessitates teachers actively involving learners with their learning process, facilitating inquiry-based study, and providing chances for true scientific inquiry. Furthermore, teachers must be skilled at meeting varied learning requirements, creating a positive classroom environment, and effectively incorporating tech into science instruction. Understanding the pedagogical approaches used by primary science teachers to teach higher standards is critical for improving scientific education and increasing students' interest and involvement in the subject. Exploring these instructors' tactics, problems, and accomplishments can provide educators with useful insights into successful methods to teaching science at this critical time of growth.

Problem Statement

Despite the growing emphasis on science instruction in schools for children, there is little research concentrating especially on teachers' pedagogical techniques in exposing students to higher standards. While many studies have looked at effective ways for providing science instruction at the elementary level, few have focused on the special difficulties and possibilities that come with teaching science to upper elementary kids. As a result, we still don't know what factors influence kids' motivation in learning science during this time, or what optimal practices are for increasing effective participation and success in the subject. This study aims to close this gap by performing a case study to investigate elementary science teachers' methodology in teaching higher standards. The purpose of this study is to identify critical elements impacting children' interest in science and to reveal successful approaches for improving the teaching of science at the elementary level by evaluating teachers' strategies, experiences, and perspectives. We expect that this analysis will help to the currently underway attempts to improve the teaching of science and improve scientific comprehension among primary pupils.

Research Objective

There are several significant linkages between the students' interest in science and the teachers' practises in teaching science. Thus, a study is needed to achieve the following objectives.

i. To investigate the elementary science teachers' pedagogy in teaching upper standards.
ii. To Identify the key factors in shaping students' Interest in learning Science.
iii. To identify the best practices in teaching Science.

Significant of study

This study is significant for primary science education stakeholders because it provides insights into excellent upper elementary science teaching practices, which will help instructors improve their instructional strategies. Understanding the elements that influence pupil fascination in science can help to increase engagement, create more inclusive learning environments, and address imbalances in science education. Furthermore, the data can be used to guide curriculum development, ensuring that curricula are relevant to students' needs and interests. Policymakers can utilise the study's empirical information to drive decisions concerning curricular standards and budget allocation, resulting in improved scientific teaching in primary schools.

2. Literature Review

Teachers' pedagogy in teaching science for upper elementary standard

Scientific teachers play an important role in developing excellent instructional and educational activities for scientific lessons. Effective science instruction in the primary grades is critical for developing children' scientific comprehension and preparing them to achieve subsequent academic achievement. The ideas and practices that teacher have are critical to understanding

and enhancing educational processes. For example, the findings suggest a critical need for targeted professional development programs to enhance teachers' skills in modern pedagogical techniques, technology integration, and updated scientific knowledge. Revisions in teacher education curricula, emphasising practical training and hands-on experiences, are essential to address these gaps (Baniqued & Bautista, 2024). According to research, educational approaches have a considerable impact on the quality of upper-level science education. The National Science Education Standards (NSES) promote inquiry-based learning, which encourages students to actively engage in scientific inquiry, investigation (hands-on activities), and collaboration. Students' educational experiences and final results are influenced by teachers' pedagogical practices, which include methods of teaching, resource utilisation, and classroom management measures. Studying the pedagogical approaches used by primary science teachers to teach higher standards is critical for improving scientific education and increasing students' academic progress in science. In order to implement the the scientific community of learning and growth, educator development looks at both the "what" of teacher preparation—the knowledge instructors need to support children's learning and development—and the "how"—the methods for educator discovering that can result in profound comprehension, advanced abilities (Hammond et al., 2023). This in turn promotes a scientifically educated society by making STEM areas more globally competitive. For students, instructors, and the larger educational system to develop holistically, these gaps must be filled. Traditional teaching techniques, abstract ideas, and a dearth of practical experiences frequently lead to student disinterest and decreased enthusiasm for science courses. In order for students to acquire science process skills like identifying variables, utilising the right equipment to collect data, and analysing data to respond to the inquiry questions, teachers should provide them the chance to organise and carry out investigations (Ambusaidi & Al.Maqbali, 2022). Though kids are born to have a natural aptitude to learn, their success is heavily contingent on the engagement of teachers. Sometimes students' energy, ambition, and passion for a subject or endeavour decrease, necessitating ongoing reinforcement through external help. Classroom Teachers, who are in charge of providing an atmosphere of encouragement that promotes and enhances student learning, frequently give this external help. Teachers' role in enabling students' motivation is regarded as supporting the development of students' independence, relevance, connection to and competency in teachers' interests, and their own confidence in teaching their topic. Though students' motivation to study might be either internal or external, the teacher's role in facilitating their development and establishing an appropriate environment will increase their enthusiasm to learn.

Key factors that attract students' interests in learning science

Many factors motivate students to learn. These factors may be intrinsic or extrinsic. According to (Tram Le et al., 2024), they believe that the chance to acquire and practise skills and expand knowledge makes intrinsic motivation extremely significant. The desire to be autonomous, self-sufficient at work, and to accomplish anything via their efforts is another significant factor while extrinsic benefits drive people who have not been assigned as full-time employees, whereas internal rewards drive full-time employees. Though motivation can be intrinsic or extrinsic, it is important for teachers to create an environment that motivates students' learning. Several factors affect how interested pupils are in studying science, including teacher practices, classroom climate, and curriculum content. Research indicates that interactive, inquiry-based learning experiences might increase students' interest and enthusiasm in science by encouraging active involvement and discovery. Furthermore, teacher excitement, support, and appreciation for student inquiry might improve students' attitudes regarding science. In addition, significance and real-world linkages in science curriculum might increase students' attention and perceived value in science education. Identifying important elements that

influence students' motivation in studying science is vital for developing effective science training that encourages engagement and creates an eternal curiosity in inquiry into the sciences. Students enjoy learning about new scientific discoveries, like to read science fiction, like to watch science-related shows on television, like to visit science museums, or are interested in the applications of science to everyday life. This suggests that scientific instruction and instruction quality are important determinants of students' interest in science (Steidtmann et al., 2022). Triggers of situational curiosity include curricular information, teaching methods, learning activities, or environmental situations in normal scientific sessions that might generate brief attention or good sensations from a large number of pupils. The characteristics of the triggers that arouse students' situational interest in regular science sessions are referred to as their sources. Because of the hands-on activity of laboratory work, it is frequently a significant activator of situational interest. Children may learn critical abilities in an entertaining and captivating way with the use of educational games and apps that concentrate on fundamental ideas like alphabet, numbers, and colours. New technology should be created to help primary school pupils (ages 6–11) achieve critical abilities including reading, writing, and maths (Akour & Alenezi, 2022). Students can learn and remember information more efficiently when they play educational games and applications that integrate storytelling, creativity, and solving issues (Garlinska et al., 2023). Teachers play a vital role in creating an environment that supports students' learning. Teachers enable students to identify with self, personal interests, and values by supporting their freedom of choice. By supporting students' choices and interests, teachers help students develop personal interest, involvement, and ownership of their work, which aid in motivation. Teachers also help students to learn by increasing their responsibility and participation in their own learning through letting them create their own goals and objectives (Davion, 2017).

To identify the best practices in teaching Science

To be effective teachers of science, elementary school teachers must be confident in both their science content knowledge across disciplines (i.e. physical, life, and earth and space) and Pedagogical Content Knowledge (PCK), or the knowledge of instructional strategies useful for teaching particular content, together with common student conceptions and difficulties with particular content. They must also understand how to transform their knowledge and understanding of science and how to conduct science in ways that effectively enable students to experience and practise the doing of science themselves (Amy, 2019). Effective scientific teaching practices include a wide range of instructional methodologies, instructional strategies, and methods for controlling the classroom. Investigation-based instruction, hands-on exploration, and sharing knowledge are all widely accepted as the most effective methods in science education. These approaches actively engage learners in their learning process, encourage problem-solving and critical thinking abilities, and create a deeper knowledge of scientific subjects. Furthermore, integrating technological and audiovisual resources can improve science training by creating engaging educational environments and simplifying access to practical applications of scientific phenomena. Technology literacy is essential in all spheres of life (Fakherji, 2019). Practices in this science methods course are on preparing teachers through high leverage practices, core practices for teaching science that could be used frequently and in multiple topics within science to support the learning and achievement of all students. High leverage practices, such as facilitating the development of students' scientific explanations to answer "why" questions (Amy, 2019). Educators can foster the experience of students learning and success in school in science by identifying and applying best practices.

3. Methodology

This paper aims to investigate elementary teachers' pedagogy in Science education for upper standards. Qualitative research design seemed to be the most suitable design to meet the purpose of this investigation The conceptual framework of this research centres around the qualitative method, with all data taken from an interview discussion with six teachers from science topics relevant to the inquiry. Given the importance of this data collection, respondents will be treated directly through in-depth interviews which that qualitative approaches are known to be time-consuming and produce substantial descriptive datasets (Cheong et al., 2023). All of the six respondents were asked to determine when the conversation would take place in order to ensure they did not feel rushed. After receiving the interviewee's permission, the telephone conversation was taped and translated to collect data and information, which was then collated to fit the theme.

To ensure the findings and results of this research is accurate and reliable, 6 interview sessions were conducted with upper standard science teachers in elementary school from different school backgrounds/levels. The interview sessions with the 6 respondents were good enough to meet the objectives for this research. The six selected samples are active at their elementary school (Sekolah Kebangsaan) in Malaysia. Two of them are excellent teachers or “Guru Cemerlang”. Both of them came from different schools. Another two of them are committee members of science subjects at school. The other one sample is also an excellent teacher but she is from cluster elementary school. All of the teachers are being set before the research is being conducted. In other words, a purposive sampling is being directed in this research.

The characteristics of the 6 respondents are as follows:

i. The Science teachers that teach the upper standard in elementary school.
ii. The period of being a science teacher is at least 5 years and above.
iii. Teachers are from different genders, both male and female.

Table 1: Background Of The Respondents

Respondents	Age	Gender	Years of Teaching Experience
A	37	Male	13 years
B	41	Female	16 years
C	52	Male	27 years
D	30	Female	5 years
E	43	Male	18 years
F	34	Female	9 years

All qualitative data were theoretically evaluated (Ormanci, 2020), with the process beginning with audio data transcription, translation, and organisation of the material received from the three instruments. The interview will be performed verbally both in person and online. Interviewers are given the option of using English or Malay while assessing respondents' requests. All interview sessions are recorded and transcribed as verification and openness of the interview process. Each responder is asked the same set of questions about the three research objectives. In this session, responders may say anything in response to the question without selecting an answer option. Participants must come up with their own words, phrases, or sentences to react. All the teachers chosen are willingly to participate and there was a thorough background check that had been done before they were being selected to be interviewed. All the teachers were given the freedom to answer the questions based on their experience or opinion. Through rigorous coding and analyses, several themes were derived.

4. Results and Findings

Table 2: The pedagogical used by the teachers in teaching science is hands-on activity

Respondents	The pedagogical used by the teachers in teaching science is hands-on activity
A	*"...If we do hands-on activities, it's even better because the children can feel for themselves…"*
C	*"...The best method is hands-on activities that involve students being able to feel, touch, see and hear. Activities such as experiments, role plays, field studies…"*
D	*"...Shows real-world applications, incorporates hands-on learning, promotes equality in education, develops critical and creative thinking, encourages independent exploration of subject matter, teaches collaboration, sparks interests in future careers, integrates other disciplines (interdisciplinary), builds resilience, etc…"*
E	*"...In addition, hands-on activities such as tests and experiments are also done a lot considering that in years 4, 5, 6 there are several topics that require tests and experiments. Through experiments, students can build concepts and can correct science misconceptions in learning through activities that have been carried out…"*
F	*"...In my opinion, the methods I always use with my pupils are hands-on activities and students' discussion…"*

The finding of this research is supported or linked from the previous research paper conducted by (Kibga et al., 2021), Practical exercises inspire students to explore and understand new information while also fostering a love of lifelong learning.

Table 3: The factors that shape students' interest in learning science is because science has more interesting activities (hands-on activities)

Respondents	The factors that shape students' interest in learning science is because science has more interesting activities (hands-on activities)
A	*"... Because of the interesting activity for example students are happy and excited when I do an activity with them, and the activity brings money to them as they sell mango pickling…"*
B	*"...Students always said to me that they love to learn science because I always did hands-on activity like experiments inside or outside the classroom where I connected it to real world situations…"*
C	*"...I did lots of hands-on activities which involved experimentation, design & field research to engage students' participation…"*
D	*"...Yes, when I did my doctoral studies that were focused on secondary school, however you may consider integrating project-based learning at elementary level as this is a new trend…"*
E	*"...Hands-on activities such as tests and experiments are also done a lot considering that in years 4, 5, 6 there are several topics that require tests and experiments, where through experiments, students can build concepts and can correct science misconceptions that exist in learning through the activities that have been carried out…"*
F	*"... What can I see in students that they love and are excited to learn science subjects because of the hands-on activities that we did in class or outside the classroom like science laboratory…"*

The findings of this research where these positive learning experiences towards hands-on work are supported by (Brockman et al., 2020), they said that hands-on laboratories help students to learn science related concepts well. Also, high levels of enjoyment are observed by students, and as a result, they feel motivated to learn interactively and participate in the experiments. Besides, according to a recent study of Adkins (2020), the students' interests and positive attitude stimulate participation in hands-on laboratory experiments.

Table 4: Teachers play a vital role in encouraging students learning Science

Respondents	Teachers play a vital role in encouraging students learning Science
A	*"...The teacher's own methods, the teacher's own approach, the teacher's aura. The teacher's aura, the teacher's personality is important, you see. The personality aura is important, you know sometimes, students are misled by us. Sometimes, they are not misled by us. So, what people say about this matter is that even if the student is stubborn, you see, it doesn't matter who they are but, when the student admires the teacher, you see, it means, like, we all have our favourite teachers, right? Our favourite teachers, you see. So, this thing also plays a role…"*
B	*"...The personality of the teacher itself is very important as they see us whenever we are teaching, the way we communicate with them, the way we approach them, the way we teach them, and etc…"*
C	*"...A teacher itself who attracts students…"*
D	*"...You as a teacher are very important as you give them inspiration to learn Science…"*

This finding is supported by past research by (Zou et al., 2023), where he asserted that pupils' motivation for studying is unquestionably influenced by teachers' motivation. While teachers can increase student motivation by fostering students' autonomy, relevance, abilities, topic interests, and self-efficacy, the ideal instructor is one who has a strong sense of rapport. According to, (Jud et al., 2023), One of the most important aspects of teachers' professional competencies in encouraging pupils to learn on their own is motivation.

Table 5: Students love science because students themselves have intrinsic motivation to learn a science subject

Respondents	Students love science because students themselves have intrinsic motivation to learn a science subject
A	*"...the next factor is the students themselves that love to learn science as they would like to know and are curious about what is Science…"*
B	*"...It doesn't matter what the teacher does, but if the student himself is interested in science, he will focus and be interested…"*
C	*"...Well, there are many psychological (e.g., students' intrinsic motivations, encouragement and guidance by adults/teachers, etc) and sociological (eg learning environment) factors…"*

The findings of this research are supported by (Siudad & Aliazas, 2022) that Science learning is effective because students are motivated to learn about science. Likewise, student motivation is important in learning science because it promotes the construction of students' understanding of science concepts.

Table 6: Best practice in teaching science is hands-on activity

Respondents	Best practice in teaching science is hands-on activity
A	*"...It means that in terms of pattern activity, it is more preferable to hands-on activity…"*
C	*"...The best method is hands-on activities that involve students being able to feel, touch, see and hear…"*
D	*"... As mentioned, shows real-world applications, incorporates hands-on learning, promotes equality in education, develops critical and creative thinking, encourages independent exploration of subject matter, teaches collaboration, sparks interests in future careers, integrates other disciplines (interdisciplinary), builds resilience, etc…"*
E	*"...The best I want to say is actually difficult because it depends on the actual topic. But the best method to teach the upper standard in science needs to be based on experiments (hands-on activities…"*
F	*"...In my opinion, the methods I always use with my pupils are hands-on activities and students' discussion…"* *"...Also, hands-on activities will increase their ability to think effectively…"*

This research findings are supported by (Mekonnen, 2020), where he said that the students prefer actual/hands-on lab activities and are done in groups. Furthermore, students would prefer

to participate in actual/ hands-on activities because doing so gives them personal experience, which allows them to learn more - learning by doing, (Mekonnen, 2020) also supports traditional hands-on laboratories which promote learning for visual learners, aural learners, read/write learners, and kinesthetics learners. Written laboratory instructions and student generated lab reports are beneficial for read/write learners, and physical manipulation of lab components is beneficial for kinesthetics learners which is the reason why most students prefer this type of laboratory setting.

5. Conclusion & Recommendation

The study investigated elementary science teachers' pedagogy in teaching science for upper standards, identifying factors influencing student interest and best practices for effective instruction. Therefore, the purpose of this study is to find the best practice in teaching science in elementary school for the upper standard which includes standard 4, 5, and 6 among science teachers who teach for upper standard students is achieved as where the relationship between elementary science teachers' pedagogy in teaching upper standards, key factors in shaping students' Interest in learning Science, and the best practices in teaching Science had answered my findings that is the best teachers elementary teachers' pedagogy in teaching Science for upper standards is ***" hands-on activity"***. Through discussions with six instructors, hands-on activities were identified as the most successful educational strategy for actively engaging pupils and promoting deeper comprehension. Teachers' excitement and encouragement were discovered to influence their views towards science, while motivational factors and the appealing nature of hands-on experiences also played important roles in developing interest. In general, hands-on activities were shown to be the most effective method of teaching science, engaging students' curiosity and enabling them to study. However, other teaching practices to improve students' learning, as stated in the six responses for reference and recommendations, include inquiry-discovery, do/copy lecture notes, discussion activity, blended learning, technology integration, project-based learning, constructivism, questioning, a conducive classroom environment, and connecting to real-life scenarios. All of these ways should be explored because children have a range of learning styles, including auditory learners, written and verbal learners, kinesthetics learners, and visual learners. This helps to ensure a balance of strengthening science proficiency in the classroom. To summarise, prioritising hands-on activity approaches can boost student engagement, motivation, and effectiveness in science education. These findings have implications for the creation of educational programmes and teacher training, with the goal of promoting effective teaching of science and scientific literacy between elementary children. To fully comprehend the relationship, more study is required to ensure that students get positive learning outcomes and advance their science education.

Based on the study's findings, as for suggestions and recommendations, elementary science teachers should prioritise hands-on learning opportunities to increase students' interest and involvement in science courses. This can be accomplished by providing chances for professional growth focused on good pedagogical techniques, expanding curriculum to incorporate greater inquiry-based activities, and creating an ideal atmosphere for learning with access to laboratory equipment and technology. Furthermore, teachers should use strategies like group collaboration and problem-solving exercises to actively engage children, involve families and the community in hands-on learning efforts, and match evaluation techniques with hands-on learning goals. Implementing these ideas can help upper elementary kids have a more enriched science education experience, create a deeper comprehension of scientific concepts, and encourage lifelong interest in STEM areas (Kibga et al., 2021).

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