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Awareness, Perceived Level of Knowledge, Safety Attitude, and Information Behavior on Nuclear Energy of High School Students

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Abstract— This study assessed awareness, knowledge, safety attitudes, and information behaviors regarding nuclear energy among 75 Filipino high school students (15 Grade 10, 39 Grade 11, 21 Grade 12) from a Region 3 science high school of Philippine DepEd. Findings revealed moderate self-rated knowledge (41.3% moderate, 54.6% not much), most frequent associations of nuclear energy with power generation (85.7%) and medical applications like radiation oncology (42.5%), cautious safety perceptions (61.2% relatively safe), strong endorsement of public acceptance (76.3% very important), and preferences for seminars (43.3%) and IAEA sources (53.3%). Spearman's correlations indicated positive links between knowledge and safety perceptions (r=.316, p<.01). Recommendations advocate curriculum integration, targeted interventions, and stratified future sampling to enhance scientific literacy amid Philippine nuclear policy debates.

Keywords— nuclear energy awareness, perceived knowledge in nuclear energy, safety attitudes in nuclear energy, information behavior in nuclear energy.

I. INTRODUCTION

In recent years, the global landscape of energy production has been shifting as nations explore cleaner and more sustainable alternatives to fossil fuels. Nuclear energy has re-emerged as a significant trend in many countries' energy strategies, driven by technological advancements, increasing energy demands, and the urgent need to reduce carbon emissions [1]. Countries in Europe, North America, and Asia are revisiting nuclear power as a critical component of their long-term energy strategies, recognizing its potential to provide low-carbon baseload electricity [2]. Emerging technologies such as small modular reactors (SMRs) and next-generation reactors continue to spark scientific and public interest, offering enhanced safety features and operational flexibility [3] [4]. These developments highlight the importance of building an informed and scientifically literate population capable of understanding the principles, benefits, and risks associated with nuclear energy.

Despite these advancements, issues persist regarding public perception, misconceptions, and limited awareness of nuclear energy, particularly among younger learners. Events such as the Chernobyl and Fukushima incidents continue to shape public fear and risk perception, with significant long-term psychological impacts on affected populations [5] [6] [7] [8]. Misinformation from social media and popular culture often overshadows scientific evidence, with media discourse frequently presenting nuclear energy through a catastrophic framework that neglects its peaceful applications [9]. The 2011 Fukushima accident, in particular, had profound effects on public perception worldwide, with studies showing bipolarized risk perceptions among residents even years after the event [10]. In the Philippine context, ongoing national discussions on reviving nuclear energy—such as the debates on the Bataan Nuclear Power Plant and the 2022 Executive Order promoting nuclear power integration—underscore the pressing need for citizens to understand the scientific, economic, environmental, and safety implications of nuclear technology. High school students, who are future voters, workforce members, and STEM professionals, represent a critical group whose perceptions may significantly influence national energy directions and policy implementation.

However, a research gap was evident. While several international studies have examined student attitudes toward nuclear energy [11] [12] [13], there is limited local research focusing specifically on Filipino high school students' perception and awareness. Existing studies tend to focus on mixed high school and tertiary-level students [14] [15]. Focusing research on high school students rather than mixing them with college students allows for a more homogeneous sample, reducing variability due to differences in age, cognitive development, and curricular exposure. High school students typically have limited exposure to nuclear technology, making it easier to assess their baseline awareness, perceptions, and misconceptions. Studying this group also provides actionable insights for early educational interventions and curriculum design, while ensuring research instruments are appropriate for their comprehension level.

Existing research in the Philippines has revealed that there is a strong motivation for the student to accept nuclear power, however, the negative perception of nuclear power including its risks poses hindrance to this adoption of nuclear technology [14] [15]. Additionally, the specific relationship between environmental awareness and nuclear energy acceptance remains underexplored in the Philippine secondary education setting.

To address this gap, the study seeks to: (1) determine the level of awareness and knowledge of high school students regarding nuclear and energy issues; (2) assess the attitudes of high school students toward nuclear energy; (3) examine the information behavior of high school students regarding nuclear energy; (4) determine the relationship between students' level of knowledge about nuclear power and their perceptions of its safety and importance of public acceptance.

Ultimately, the contribution of this study is to provide evidence-based insights that can guide educators, curriculum developers, and policymakers in integrating nuclear science concepts more effectively in the secondary curriculum. The findings may help design targeted educational interventions to address misconceptions, promote scientific literacy, and support informed decision-making among Filipino youth at a time when the country is considering nuclear energy as part of its future energy landscape. By understanding what high school students know, how they perceive nuclear technology, and what influences their attitudes, educators and policymakers can develop more effective strategies to build public understanding and acceptance of nuclear energy as a viable low-carbon energy option.

II. METHODOLOGY

Data for this study were collected using a structured self-administered questionnaire. The questionnaire was adopted from the Public Opinion Survey on Nuclear Energy in Seven FNCA Countries (2010), the findings of which were presented at the Public Information Project Leaders Meeting in February 2011 in Hanoi, Vietnam, as part of the Forum for Nuclear Cooperation in Asia (FNCA) initiative. The instrument can be divided into three main sections. Questions 1 to 6 (Q1–Q6) assessed awareness and knowledge on nuclear and energy issues, capturing general environmental and energy awareness, conceptual understanding, and self-rated knowledge. This included items on students' main environmental or energy concerns, preferred methods of power generation, perceived lowest-cost and lowest CO_2-emission methods, concepts associated with "nuclear energy," and self-rated level of knowledge about nuclear power. Questions 7 to 9 (Q7–Q9) focused on safety attitudes toward nuclear energy, measuring students' views on nuclear power safety, the importance of public acceptance in constructing nuclear plants, and attitudes toward applications such as food irradiation. Questions 10 to 13 (Q10–Q13) examined information behavior, asking students where they usually obtained information about nuclear power, which sources they considered most reliable, the type of information they most wanted to receive, and their preferred communication tools for learning about nuclear energy.

A pilot test was conducted with 30 students to assess the questionnaire. Because the instrument consisted of stand-alone categorical items, internal consistency reliability measures such as Cronbach's alpha were not computed. Instead, item-level descriptive analysis was conducted, including frequency and percentage distributions for each response option, to examine response patterns, item clarity, and instruction compliance. Similar approaches are used for other multi-domain perception instruments such as the Brief Ageing Perceptions Questionnaire [16], MULTIPleS [17], and PROMIS-57 [18].

Specifically, the nominal items were recoded into dichotomous (binary) variables through dummy coding, where each category became a separate variable coded as "1" to indicate the presence of that category and "0" to indicate its absence.

During data collection, 21 Grade 12 students, 39 Grade 11 students, and 15 Grade 10 students from a science high school under the Department of Education in Region 3 completed the questionnaire via a secure online platform, following standardized instructions to ensure uniform administration. Respondents indicated their answers by selecting from pre-defined options or providing brief written responses where applicable. The questionnaire was designed to be completed within approximately 20–30 minutes, and all responses were collected anonymously to maintain confidentiality.

The collected data were coded and analyzed using SPSS statistical software. Descriptive statistics, including

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frequencies, percentages, and means were computed to summarize students' responses. To examine relationships among variables, inferential statistics were employed. Spearman's correlation analysis was conducted to determine the associations between knowledge scores and perceptions of safety or public acceptance.

Ethical considerations were strictly observed. Permission was secured from the school authorities. Written informed consent was obtained from the student participants, and for minor students, assent was secured prior to participation along with parental consent. Participation was voluntary, and students were allowed to withdraw at any time without penalty. The questionnaires did not collect identifying information, ensuring anonymity, and all data were stored securely. Results were reported in aggregate form to protect confidentiality, and the data were scheduled for secure disposal one year after the completion of the study.

III. DISCUSSION OF RESULTS AND FINDINGS

Item Level Descriptive Analysis for Single Choice Questions

Table 1 shows the item-level analysis for Question 1, asking students to indicate their main concern. Most students (63.3%, n = 19) selected global warming, followed by water pollution (13.3%, n = 4) and air pollution (10.0%, n = 3), while few chose other options and none selected food problem or others. The responses suggest that students followed instructions correctly, indicating good compliance, and that the item was clear, as all categories received appropriate selections. The predominance of global warming demonstrates a clear response pattern, confirming the item effectively captured students' environmental concerns.

Table 1. *Analysis for Question #1(Which of the following issues are you most concerned with? N=30)*

Option	Number of response (n)	(%)
Air pollution	3	10.0
Water pollution	4	13.3
Food problem (food safety, food shortage)	0	0.0
Energy problem	1	3.3
Global warming	19	63.3
Radioactive pollution	2	6.7
Forest destruction	1	3.3
Others	0	0.0

Table 2. *Analysis for Question #2 (Which method of power generation do you think is the best? N=30)*

Option	Number of response (n)	(%)
Thermal power generation	1	3.3
Water (hydro) power generation	3	10
Nuclear power generation	10	33.3
Solar energy generation	13	43.3
Wind power generation	2	6.7
Geothermal power generation	1	3.3
Others	0	0.0

Table 2 presents the item-level analysis for Question 2, which asked students to identify the best method of power generation. Most students selected solar energy generation (43.3%, n = 13), followed by nuclear power generation (33.3%, n = 10). Fewer students chose water (hydro) power (10%, n = 3), wind power (6.7%, n = 2), thermal power (3.3%, n = 1), or geothermal power (3.3%, n = 1), and no respondents selected other options.

The responses indicate that students followed instructions correctly, selecting only one option, and that the item was clear, as all categories received some selections. The predominance of solar and nuclear power demonstrates a clear response pattern, confirming the item effectively captured students' perceptions of preferred power generation methods.

Table 3. *Analysis for Question #3 (Which method of power generation do you think has the lowest electricity cost? N=30)*

Option	Number of response (n)	(%)
Thermal power generation	2	6.7
Water (hydro) power generation	3	10
Nuclear power generation	4	13.3
Solar energy generation	15	50.0
Wind power generation	6	20.0
Geothermal power generation	0	0.0
Others	0	0.0

Table 3 presents the item-level analysis for Question 3, which asked students to indicate which method of power generation they believed had the lowest electricity cost. The majority of students selected solar energy generation (50.0%, n = 15), followed by wind power (20.0%, n = 6) and nuclear power (13.3%, n = 4).

Fewer students chose water (hydro) power (10.0%, n = 3) or thermal power (6.7%, n = 2), and no respondents selected geothermal power or other options.

The responses indicate that students followed instructions correctly, selecting only one option, and that the item was clear, as all meaningful categories received selections.

The clear preference for solar energy reflects a distinct response pattern, confirming that the item effectively captured students' perceptions of electricity cost by generation method.

Table 4. *Analysis for Question #6 (What is the extent of your knowledge about nuclear power? N=30)*

Option	Number of response (n)	(%)
Well	0	0.0
Moderate	15	50.0
Not much	15	50.0
Nothing	0	0.0

Table 4 presents the item-level analysis for Question 6, which asked students to indicate their extent of knowledge about nuclear power.

Responses were evenly split, with 50.0% (n = 15) reporting moderate knowledge and 50.0% (n = 15) reporting not much. No students selected well or nothing.

The distribution indicates that students followed instructions correctly and that the item was clear, showing a balanced pattern of self-assessed knowledge levels.

In survey analysis, when responses are roughly equal across categories, it is often described as a "balanced pattern," meaning there isn't skew toward one side.

Table 5. *Analysis for Question #7 (Do you think nuclear power is safe or not? N=30)*

Option	Number of response (n)	(%)
Safe	4	13.3
Relatively Safe	21	70.0
Not Safe	4	13.3
Don't know	1	3.3

Table 5 presents the item-level analysis for Question 7, which asked students about their perception of nuclear power safety. Most students considered it relatively safe (70.0%, n = 21), while fewer perceived it as safe (13.3%, n = 4) or not safe (13.3%, n = 4). Only one student selected don't know (3.3%).

The responses indicate that students followed instructions correctly and that the item was clear, with a clear pattern showing a predominant perception of relative safety.

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Table 6. *Analysis for Question #8 (In your opinion, is public acceptance important for construction of nuclear power plant? N=30)*

Option	Number of response (n)	(%)
Very important	21	70.0
Somewhat important	8	26.7
Not so important	1	3.3
Not important at all	0	0.0
Don't know	0	0.0

Table 6 presents the item-level analysis for Question 8, which asked students about the importance of public acceptance in constructing nuclear power plants. The majority of students rated it as very important (70.0%, n = 21) or somewhat important (26.7%, n = 8), with only one student selecting not so important (3.3%), and no students choosing not important at all or don't know. The distribution indicates that students followed instructions correctly and that the item was clear, with a strong response pattern highlighting the perceived importance of public acceptance.

Table 7 presents the item-level analysis for Question 9, which asked students about their opinion on food irradiation. Most students reported feeling a little anxious about its safety but thought it should be used (76.7%, n = 23), while fewer felt safe and supported active use (10.0%, n = 3) or were anxious and opposed (13.3%, n = 4). No students selected "others." The distribution indicates that students followed instructions correctly and understood the item since students selected mutually exclusive categories, and "Others" was not misused, showing a clear pattern of cautious acceptance toward food irradiation.

Table 7. *Analysis for Question #9 (Radiation is used in various fields. What is your opinion on "food irradiation" which sterilizes foods using radiation? N=30)*

Option	Number of response (n)	(%)
Feel safe and it should be actively used	3	10.0
Feel a little anxious about its safety, but it should be used	23	76.7
Anxious about its safety, and it should not be used	4	13.3
Others	0	0.0

Table 8. *Analysis for Question #11 (Which source do you think is the most reliable for obtaining information on nuclear power? N=30)*

Option	Number of response (n)	(%)
Mass media such as newspaper and television	1	3.3
Internet	1	3.3
Books	1	3.3
Electric utilities	0	0.0
Governmental organization	0	0.0
Scientific institutions	5	16.7
Local government	0	0.0
Teacher or professor	0	0.0
Experts such as scientists	6	20.0
International organizations such as IAEA	16	53.3

Table 8 presents the item-level analysis for Question 11, which asked students to identify the most reliable source of information on nuclear power. The majority of students selected international organizations such as the International Atomic Energy Agency (IAEA) (53.3%, n = 16), followed by experts such as scientists (20.0%, n = 6) and scientific institutions (16.7%, n = 5). Very few students chose mass media, internet, or books (3.3% each, n = 1), and no students selected electric utilities, governmental organizations, local government, or teachers/professors. The distribution indicates that students followed instructions correctly, understood the

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item, and showed a clear preference for authoritative and expert sources, reflecting discernible response patterns and adequate item clarity.

Table 9 presents the item-level analysis for Question 12, which asked students which information about nuclear power they most wanted to know first. Most students prioritized effects on the environment (43.3%, n = 13), followed by effects on health (23.3%, n = 7) and safety in plant operations (23.3%, n = 7). Very few students chose energy security, cost benefit, or regional benefits (3.3% each, n = 1). The distribution indicates that students followed instructions correctly, understood the item, and displayed a clear pattern of concern for environmental and health-related information, suggesting good item clarity and response compliance.

Table 9. *Analysis for Question #12 (Which is the first information on nuclear power do you want to know? N=30)*

Option	Number of response (n)	(%)
Energy Security	1	3.3
Cost benefit	1	3.3
Effect to the environment	13	43.3
Effect to health	7	23.3
Safety in the operation of the plant	7	23.3
Regional benefit such as employment	1	3.3

Table 10. *Analysis for Question #13 (Which communication tool do you think is the most effective? N=30)*

Option	Number of response (n)	(%)
Convening seminar, symposium, dialogue, conference, and other similar activities	13	43.3
Brochures and other publications	1	3.3
Information service using internet	4	13.3
Exhibition	1	3.3
Facilities for public relations such as science museum and exhibition pavilion	8	26.7
Newspaper	0	0.0
Television	0	0.0
Radio	1	3.3
Videos	2	6.7
Other	0	0.0

Table 10 presents the item-level analysis for Question 13, which asked students to identify the most effective communication tool for learning about nuclear power. The majority of students selected convening seminars, symposiums, dialogues, and similar activities (43.3%, n = 13), followed by facilities for public relations such as science museums and exhibition pavilions (26.7%, n = 8) and information services using the internet (13.3%, n = 4). Fewer students chose videos, brochures, exhibitions, or radio (3.3% to 6.7%), and no students selected newspaper, television, or other options. The distribution indicates that students followed instructions correctly, understood the item, and displayed a clear preference for interactive and facility-based communication tools, reflecting discernible response patterns and good item clarity.

Item Level Descriptive Analysis for Multiple-Response Questions

Table 11. *Analysis for Question #4 (Which method of power generation do you think emits less carbon dioxide (CO2) when generating electricity? N=30)*

Option	Number of response (n)	(%)
Thermal power generation	3	10.0
Water (hydro) power generation	20	66.7
Nuclear power generation	8	26.7
Solar energy generation	20	66.7

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Wind power generation	22	73.3
Geothermal power generation	4	13.3
Others	0	0.0

Table 11 presents the item-level analysis for Question 4, which asked students to select all power generation methods they believed emitted less carbon dioxide (CO_2). The majority of students identified wind power (73.3%, n = 22), water (hydro) power (66.7%, n = 20), and solar energy (66.7%, n = 20) as low-emission options. Fewer students selected nuclear power (26.7%, n = 8), geothermal power (13.3%, n = 4), or thermal power (10.0%, n = 3), and no respondents chose other options. The responses indicate that students were able to follow instructions for multiple selections, demonstrating good instruction compliance, and that the item was clear, as all relevant categories received responses. The distinct selection patterns highlight students' awareness of low-carbon energy sources.

Table 12. *Analysis for Question #5 (What comes into your mind when you hear or read the word "nuclear energy"? N=30)*

Option	Number of response (n)	(%)
Food irradiation	4	13.3
Radiation oncology	15	50.0
Accelerator	2	6.7
Nuclear power generation	24	80.0
Atomic bomb	12	40.0
Others	0	0.0

Table 12 shows the item-level analysis for Question 5, which asked what comes to mind when students hear "nuclear energy." Most students selected nuclear power generation (80.0%, n = 24) and radiation oncology (50.0%, n = 15), while fewer chose atomic bomb (40.0%, n = 12), food irradiation (13.3%, n = 4), or accelerator (6.7%, n = 2). No respondents selected other options. The responses indicate that students followed instructions correctly, and the item was clear, with a discernible pattern showing that nuclear energy is primarily associated with power generation and medical applications.

Table 13. *Analysis for Question #10 (From which sources of information do you usually get your information on nuclear power? N=30)*

Option	Number of response (n)	(%)
Newspaper	1	3.3
Television	10	33.3
Radio	1	3.3
Magazine	0	0.0
Internet	27	90.0
Pamphlet	1	3.3
School textbooks	6	20.0
School teachers	17	56.7
Exhibitions/Fairs	5	16.7
DVD/Videos	1	3.3
Seminars, symposium, conference and similar activities	12	40.0

Table 13 presents the item-level analysis for Question 10, which asked students about their usual sources of information on nuclear power.

The internet was the most frequently cited source (90.0%, n = 27), followed by school teachers (56.7%, n = 17) and seminars, symposiums, or conferences (40.0%, n = 12). Other sources included television (33.3%, n = 10), school textbooks (20.0%, n = 6), exhibitions or fairs (16.7%, n = 5), and newspaper, radio, pamphlets, or DVDs (3.3%, n = 1 each), while magazines were not selected at all. The distribution

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shows that students followed instructions correctly, provided multiple selections as intended, and understood the item, reflecting clear response patterns on sources that promotes interaction.

Profile of Respondents

Table 14. *Percentage of Male and Female Students (N=30)*

Grade level	Male	Female	Total
Grade 10	3 (10%)	12 (80%)	15 (100%)
Grade 11	10 (25.6%)	29 (74.4%)	39 (100%)
Grade 12	8 (31.8%)	13 (61.9%)	21 (100%)

Table 14 shows that female students predominate across all grade levels in the survey on nuclear energy. In Grade 10, females represent 80% of the respondents, with males at 10%. In Grade 11, females account for 74.4%, while males comprise 25.6%. In Grade 12, females make up 61.9% of the students, with males at 31.8%. This gender imbalance may influence the survey results, as research indicates that males and females can differ in risk perception and attitudes toward technological issues [19] [20].

Awareness and Knowledge of Nuclear and Energy Issues

Table 15. *Issues of Concern to Students (Responses to Q1)*

Option	Grade 10	Grade 11	Grade 12	Mean
Air pollution	0%	17.9%	9.5%	9.13%
Water pollution	20%	7.7%	14.3%	14.0%
Food problem (food safety, food shortage)	0%	2.6%	9.5%	4.03%
Energy problem	0%	12.8%	4.8%	5.87%
Global warming	66.7%	56.4%	47.6%	56.9%
Radioactive pollution	6.7%	0%	9.5%	5.40%
Forest destruction	6.7%	2.6%	4.8%	4.70%
Others	0%	0%	0%	0.00%

Concerns directly related to energy problems and radioactive pollution, which are more closely associated with nuclear energy, are comparatively low (See Table 15). Energy problems register modest awareness, particularly in Grade 11 (12.8%), while radioactive pollution remains a minor concern across all grades, with responses not exceeding 9.5%. This pattern indicates limited explicit awareness or prioritization of nuclear-specific risks among students.

The findings suggest that while students demonstrate strong awareness of general environmental issues, particularly global warming, their knowledge and concern about nuclear- and energy-specific issues appear less developed, highlighting a potential gap that could be addressed through targeted energy and nuclear education.

Table 16. *Preferred Methods of Power Generation among Students (Responses to Q2)*

Option	Grade 10	Grade 11	Grade 12	Mean
Thermal power generation	0%	10.3%	4.8%	5.03%
Water (hydro) power generation	6.7%	7.7%	4.8%	6.4%
Nuclear power generation	13.3%	12.8%	47.6%	24.6%
Solar energy generation	73.3%	59.0%	38.1%	56.8%
Wind power generation	0%	5.1%	0%	1.7%

Geothermal power generation	6.7%	5.1%	4.8%	5.53%
Others	0%	0%	0%	0%

Table 16 indicates that students across all grade levels show a strong preference for renewable energy, particularly solar power, which records the highest mean (56.8%) and is most favored by Grade 10 (73.3%) and Grade 11 (59.0%) students. In contrast, preference for nuclear power varies by grade, remaining low in Grades 10 (13.3%) and 11 (12.8%) but increasing markedly in Grade 12 (47.6%), resulting in a mean of 24.6%. This pattern suggests that greater educational exposure at higher grade levels may be associated with more favorable views of nuclear energy. Overall, the findings highlight a strong inclination toward renewable sources, alongside a growing acceptance of nuclear power among older students, indicating more differentiated energy perspectives with advancing grade level.

Table 17. *Student-Perceived Lowest-Cost Methods of Power Generation (Responses to Q3)*

Option	Grade 10	Grade 11	Grade 12	Mean
Thermal power generation	6.7%	7.7%	14.3%	9.6%
Water (hydro) power generation	13.3%	15.4%	4.8%	11.1%
Nuclear power generation	6.7%	5.1%	42.9%	18.2%
Solar energy generation	46.7%	48.7%	28.6%	41.3%
Wind power generation	26.7%	15.4%	9.5%	17.2%
Geothermal power generation	0%	7.7%	0%	2.6%
Others	0%	0%	0%	0%

Table 17 shows that students generally perceive solar energy as the lowest-cost power generation method across all grade levels, with the highest mean (41.3%), particularly among Grades 10 and 11. In contrast, nuclear power is rarely viewed as low-cost by younger students but is increasingly recognized as such by Grade 12 respondents (42.9%), resulting in a higher overall mean (18.2%). This pattern suggests that perceptions of energy cost become more nuanced with advancing grade level. Overall, younger students tend to associate affordability with renewable energy, while older students demonstrate greater awareness of the potential cost efficiency of nuclear power.

Table 18 shows that students across all grade levels strongly associate renewable energy sources with low carbon emissions, particularly solar (67%), hydro (61.3%), and wind (61.3%). Recognition of nuclear power as a low-carbon option is moderate but increases with grade level, from 20% in Grade 10, to 23.1% in Grade 11 to 38.1% in Grade 12. Thermal power is rarely viewed as low-carbon. Overall, the results indicate high awareness of renewables' low-carbon profiles, alongside a growing but still limited understanding of nuclear energy's low-carbon role.

Table 18. *Student-Perceived Lowest-Carbon Power Generation Methods (Responses to Q4)*

Option	Grade 10	Grade 11	Grade 12	Mean
Thermal power generation	0%	7.7%	0%	2.6%
Water (hydro) power generation	60%	61.5%	61.9%	61.3%
Nuclear power generation	20%	23.1%	38.1%	27%
Solar energy generation	73.3%	61.5%	66.7%	67%
Wind power generation	60%	66.7%	57.1%	61.3%
Geothermal power generation	13.3%	25.6%	14.3%	17.7%
Others	0%	0%	0%	0%

Table 19. *Student Word Associations with "Nuclear Energy" (Responses to Q5)*

Option	Grade 10	Grade 11	Grade 12	Mean
Food irradiation	13.3%	7.7%	0%	7%
Radiation oncology	46.7%	33.3%	47.6%	42.5%

Accelerator	13.3%	5.1%	19%	12.5%
Nuclear power generation	86.7%	84.6%	85.7%	85.7%
Atomic bomb	40%	43.6%	19%	34.2%
Low Risk High Reward	0%	0%	4.8%	1.6%

Table 19 shows that students primarily associate nuclear energy with power generation (85.7%), followed by radiation oncology (42.5%), indicating recognition of both energy and medical applications. Associations with atomic bombs remain notable (34.2%), reflecting lingering risk-related perceptions. Other applications, such as food irradiation and low-risk, high-reward uses, are rarely recognized. Overall, students' perceptions are dominated by energy and medical contexts, with limited awareness of broader industrial or societal applications.

Table 20. *Perceived Knowledge of Students about Nuclear Power (Responses to Q6)*

Option	Grade 10	Grade 11	Grade 12	Mean
Well	0%	2.6%	9.5%	4.03%
Moderate	46.7%	48.7%	28.6%	41.3%
Not much	53.3%	48.7%	61.9%	54.6%
Nothing	0%	0%	0%	0%

Table 20 indicates that students generally perceive their knowledge of nuclear power as limited, with the majority across all grade levels reporting that they know "not much" about the topic (mean = 54.6%). A substantial proportion of students rate their knowledge as moderate (mean = 41.3%), suggesting partial familiarity rather than in-depth understanding. Only a small fraction of respondents, primarily in Grade 12 (9.5%), consider themselves well-informed, resulting in a low overall mean (4.03%). Notably, no students reported having no knowledge at all. Overall, the findings suggest that while students possess some basic awareness of nuclear power, deeper understanding remains limited, highlighting the need for more comprehensive nuclear energy education, particularly at the secondary level.

Safety Attitudes toward Nuclear Energy

Table 21. *Perception of Safety of Students about Nuclear Power (Responses to Q7)*

Option	Grade 10	Grade 11	Grade 12	Mean
Safe	0%	12.8%	28.6%	13.8%
Relatively Safe	66.7%	69.2%	47.6%	61.2%
Not Safe	20%	15.4%	19%	18.1%
Don't know	13.3%	2.6%	4.8%	6.9%

Table 21 underscores the persistence of safety concerns and uncertainty about nuclear power across all grade levels. A consistent proportion of students perceive nuclear power as not safe (mean = 18.1%), indicating that risk perceptions remain stable and are not substantially reduced in higher grades. Although uncertainty ("don't know") is highest in Grade 10, it is still evident in Grades 11 and 12, suggesting that ambiguity regarding nuclear power safety persists even among older students.

Generally, the findings highlight enduring risk perceptions and unresolved uncertainty, pointing to the need for clearer and more targeted instruction on nuclear power safety.

Table 22. *Importance of public acceptance for construction of nuclear power plant (Responses to Q8)*

Option	Grade 10	Grade 11	Grade 12	Mean
Very important	73.3%	79.5%	76.2%	76.3%
Somewhat important	26.7%	20.5%	19%	22.1%
Not so important	0%	0%	4.8%	1.6%

Not important at all	0%	0%	0%	0%
Don't know	0%	0%	0%	0%

Table 22 shows a strong consensus across all grade levels that public acceptance is important in the construction of nuclear power plants. The majority of students rate it as very important (mean = 76.3%), while most remaining respondents consider it somewhat important (mean = 22.1%). Minimal disagreement and the absence of uncertainty indicate broad recognition of the social dimension of nuclear energy development, underscoring students' awareness of the role of public trust in nuclear power policy and implementation.

Table 23. *Student Opinions on Food Irradiation Safety (Responses to Q9)*

Option	Grade 10	Grade 11	Grade 12	Mean
Feel safe and it should be actively used	6.7%	15.4%	23.8%	15.3%
Feel a little anxious about its safety, but it should be used	80%	69.2%	61.9%	70.4%
Anxious about its safety, and it should not be used	13.3%	15.4%	14.3%	14.3%
Others	0%	0%	0%	0%

Table 23 illustrates students' perceptions of food irradiation safety across grade levels. The majority of students express some degree of caution, with 70.4% feeling a little anxious but supporting its use, indicating cautious acceptance of the technology. A smaller proportion (15.3%) feel fully safe and endorse active use, while roughly 14.3% are anxious and oppose its use, reflecting persistent safety concerns. Notably, the proportion of students who feel fully safe increases with grade level, from 6.7% in Grade 10 to 23.8% in Grade 12, suggesting a gradual shift toward greater confidence among older students. Overall, the findings highlight that while cautious acceptance predominates, safety apprehensions remain, underscoring the need for education to address both the benefits and risks of food irradiation.

Information Behavior Regarding Nuclear Energy

Table 24. *Sources of Information on Nuclear Power (Responses to Q10)*

Option	Grade 10	Grade 11	Grade 12	Mean
Newspaper	6.7%	5.1%	0%	3.9%
Television	40%	46.2%	42.9%	43%
Radio	0%	7.7%	4.8%	4.2%
Magazine	0%	0%	0%	0%
Internet	93.3%	94.9%	90.5%	92.9%
Pamphlet	6.7%	0%	4.8%	3.8%
School textbooks	26.7%	43.6%	23.8%	31.4%
School teachers	46.7%	46.2%	47.6%	46.8%
Exhibitions/Fairs	13.3%	5.1%	9.5%	9.3%
DVD/Videos	6.7%	5.1%	4.8%	5.5%
Seminars, symposium, conference and similar activities	33.3%	23.1%	42.9%	33.1%

Table 24 presents students' reported sources of information on nuclear power across grade levels. The Internet emerges as the most dominant source (mean = 92.9%), indicating that students heavily rely on online resources for information. School teachers (46.8%) and television (43%) are also significant sources, while school textbooks provide moderate support (31.4%). Other traditional media, such as newspapers, radio, pamphlets, and DVDs, are minimally used. Participation in seminars, symposiums, or similar activities shows moderate engagement (33.1%), whereas magazines are not reported as a source at all. Overall, the findings suggest that students' knowledge of nuclear power is primarily shaped by digital media and classroom interactions, with limited reliance on print or broadcast sources, highlighting the central role of the Internet and teachers in shaping students' understanding of nuclear energy.

Table 25. *Most Reliable Source for Obtaining Information on Nuclear Power (Responses to Q11)*

Option	Grade 10	Grade 11	Grade 12	Mean
Mass media such as newspaper and television	13.3%	2.6%	4.8%	6.9%
Internet	0%	5.1%	9.5%	4.9%
Books	6.7%	2.6%	0%	3.1%
Electric utilities	0%	0%	0%	0%
Governmental organization	0%	0%	0%	0%
Scientific institutions	20%	12.8%	33.3%	22%
Local government	0%	0%	0%	0%
Teacher or professor	0%	0%	0%	0%
Experts such as scientists	13.3%	25.6%	14.3%	17.7%
International organizations such as IAEA	46.7%	51.3%	38.1%	45.4%

Table 25 reflects students' perceptions of the most reliable sources for information on nuclear power across grade levels. Across all grades, international organizations such as the IAEA are regarded as the most trustworthy source (mean = 45.4%), indicating strong student confidence in authoritative global institutions. Scientific institutions (22%) and experts such as scientists (17.7%) are also valued, reflecting recognition of specialized knowledge. In contrast, commonly accessed media sources, including mass media (6.9%) and the Internet (4.9%), are perceived as less reliable, despite being heavily used for information. Traditional sources such as books, teachers, governmental organizations, and electric utilities are minimally cited or not cited at all. Overall, the findings suggest that while students rely on digital and classroom sources for information, they distinguish these from sources they perceive as authoritative and specialized, favoring international and scientific institutions when evaluating reliability.

Table 26 shows the topics students are most interested in when first learning about nuclear power. Across all grade levels, environmental effects (mean = 38.5%) and safety in plant operation (mean = 35.4%) are the top areas of interest, indicating that students prioritize understanding the ecological and operational risks of nuclear energy.

Concerns about health effects are also noted (mean = 17.9%), while issues such as energy security, cost-benefit, and regional benefits receive minimal attention. Overall, the findings suggest that students' initial information needs are strongly oriented toward risk and safety considerations, reflecting a focus on the potential hazards and responsible management of nuclear power.

Table 26. *The First Information on Nuclear Power the Students Want To Know (Responses to Q12)*

Option	Grade 10	Grade 11	Grade 12	Mean
Energy Security	0%	2.6%	9.5%	4%
Cost benefit	0%	5.1%	0%	1.7%
Effect to the environment	46.7%	30.8%	38.1%	38.5%
Effect to health	26.7%	12.8%	14.3%	17.9%
Safety in the operation of the plant	26.7%	46.2%	33.3%	35.4%
Regional benefit such as employment	0%	2.6%	4.8%	2.5%

Table 27. *Most Effective Communication Tool as Perceived by Students (Response to Q13)*

Option	Grade 10	Grade 11	Grade 12	Mean
Convening seminar, symposium, dialogue, conference, and other similar activities	26.7%	56.4%	52.4%	45.2%
Brochures and other publications	0%	2.6%	0%	0.9%
Information service using internet	20%	17.9%	19%	18.9%
Exhibition	6.7%	2.6%	0%	3.1%

Facilities for public relations such as science museum and exhibition pavilion	40%	15.4%	23.8%	26.4%
Newspaper	0%	0%	0%	0%
Television	0%	0%	0%	0%
Radio	0%	2.6%	0%	0.9%
Videos	6.7%	2.6%	4.8%	4.7%
Other	0%	0%	0%	0%

Table 27 illustrates students' perceptions of the most effective communication tools for learning about nuclear power. Across all grade levels, seminars, symposiums, dialogues, and similar activities are perceived as the most effective method (mean = 45.2%), particularly among Grades 11 and 12, indicating a preference for interactive, participatory learning formats. Facilities for public relations, such as science museums and exhibition pavilions, are also moderately valued (mean = 26.4%), especially by Grade 10 students. Use of the Internet for information services is recognized to a lesser extent (mean = 18.9%), while traditional media, brochures, and audiovisual tools receive minimal attention. Generally, the findings suggest that students favor engaging, experiential, and interactive approaches over passive or traditional media for effective communication on nuclear energy topics.

Relationship between Students' Knowledge of Nuclear Power and Their Perceptions of Safety and Public Acceptance

Table 28. *Non-Parametric Correlation of Knowledge Level with Safety Perception and Importance of Public Acceptance*

	Level of Knowledge	Perception of Safety	Importance of Public Acceptance
Level of Knowledge	1.00		
Perception of Safety	.316**	1.00	
Importance of Public Acceptance	-.054	-.008	1.00

Note (a): $|\rho| \geq 0.70$ Very Strong Relationship, $0.40 \leq |\rho| < 0.69$ Strong Relationship, $0.30 \leq |\rho| < 0.39$ Moderate Relationship, $0.20 \leq |\rho| < 0.29$ Weak Relationship, $0.01 \leq |\rho| < 0.19$ None or Negligible Relationship (Dancey & Reidy, 2004)[21]

Note (b): Values marked with double asterisks (**) are significant at the 0.01 alpha level ($p < 0.01$)

Table 28 presents the results of a Spearman rank-order correlation analysis examining the relationships among students' level of knowledge about nuclear power, their perceptions of its safety, and the perceived importance of public acceptance. The analysis reveals a statistically significant positive correlation between level of knowledge and perception of safety ($\rho = .316$, $p < .01$), indicating a moderate relationship based on the criteria of Dancey and Reidy (2004). This suggests that students who report higher levels of knowledge about nuclear power tend to perceive it as safer.

In contrast, the relationships between level of knowledge and importance of public acceptance ($\rho = -.054$) is negligible and not statistically significant. These findings indicate that students' views on the importance of public acceptance are largely independent of both their self-reported knowledge. Overall, the results suggest that increased knowledge is associated with more favorable safety perceptions, but does not significantly influence students' recognition of the importance of public acceptance in nuclear power development.

IV. CONCLUSION

This study found that high school students possess limited self-reported knowledge of nuclear energy despite strong awareness of general environmental issues. Nuclear power is generally perceived as relatively safe, although persistent safety concerns and uncertainty remain. While higher knowledge is moderately associated with more favorable safety perceptions, it does not significantly affect views on the importance of public acceptance, which students consistently consider essential. Students primarily obtain information from the Internet and schools but regard international organizations, scientific institutions, and experts as the most reliable sources, revealing a gap between information access and perceived credibility. These findings highlight the need for concise, credible, and interactive nuclear energy education at the secondary level to support informed student understanding.

V. RECOMMENDATIONS

The findings highlight gaps in students' nuclear knowledge and safety perceptions, necessitating targeted interventions to enhance literacy and acceptance. The recommendations below offer pathways for educators and policymakers:

Embed nuclear science modules in K-12 curricula, emphasizing low-carbon benefits and safety via Philippine Nuclear Research Institute (PNRI) materials and teacher training.

Prioritize IAEA and expert sources in seminars and exhibits, addressing environmental and safety concerns.

Implement school dialogues and field trips to enhance acceptance.

The female-dominated sample (61.9% to 80%) from one Region 3 science high school limits generalizability. Future studies should use stratified sampling across genders, regions, and school types.

REFERENCES

[1] Addo, E. K., Kabo-bah, A. T., Diawuo, F. A., & Debrah, S. K. (2023). The role of nuclear energy in reducing greenhouse gas (GHG) emissions and energy security: a systematic review. International Journal of Energy Research, 2023(1), 8823507.

[2] Kosowski, P. (2024). From Fossil Fuels to Renewables: Clustering European Primary Energy Production from 1990 to 2022. Energies, 17(22), 5596.

[3] Nøland, J. K., Hjelmeland, M., Tjernberg, L. B., & Hartmann, C. (2024). The race to realize small modular reactors: Rapid deployment of clean dispatchable energy sources. IEEE Power and Energy Magazine, 22(3), 90-103.

[4] Momin, R. (2023). Physics-Driven Cost Optimization and Advanced Research & Development (R&D) Strategies for Small Modular Reactors (SMRs) in Leading Nuclear Energy Nations. arXiv preprint arXiv:2307.12989.

[5] Laughlin, J. M. (2023). Some observations on perceptions of radiation risks in the context of nuclear power plant accidents. Radiation Protection Dosimetry, 199(18), 2169-2173.

[6] Bromet, E. J., Havenaar, J. M., & Guey, L. T. (2011). A 25 year retrospective review of the psychological consequences of the Chernobyl accident. Clinical Oncology, 23(4), 297-305.

[7] Shigemura, J., Terayama, T., Kurosawa, M., Kobayashi, Y., Toda, H., Nagamine, M., & Yoshino, A. (2021). Mental health consequences for survivors of the 2011 Fukushima nuclear disaster: a systematic review. Part 1: psychological consequences. CNS spectrums, 26(1), 14-29.

[8] Terayama, T., Shigemura, J., Kobayashi, Y., Kurosawa, M., Nagamine, M., Toda, H., & Yoshino, A. (2021). Mental health consequences for survivors of the 2011 Fukushima nuclear disaster: a systematic review. Part 2: emotional and behavioral consequences. CNS spectrums, 26(1), 30-42.

[9] Wang, R. (2025). Public attitudes and sustainability perceptions towards nuclear power: Evidence from Chinese social media data mining. Energy Strategy Reviews, 62, 101928.

[10] Takebayashi, Y., Lyamzina, Y., Suzuki, Y., & Murakami, M. (2017). Risk perception and anxiety regarding radiation after the 2011 Fukushima nuclear power plant accident: A systematic qualitative review. International journal of environmental research and public health, 14(11), 1306.

[11] Yılmaz, V., & Bilge, Y. (2018). Attitudes of University Students on Nuclear Power Plants: A Proposal of the Structural Equation Model. Alphanumeric Journal, 6(1), 133-150.

[12] Berényi, L., Birkner, Z., & Deutsch, N. (2020). A multidimensional evaluation of renewable and nuclear energy among higher education students. Sustainability, 12(4), 1449.

[13] Pilakouta, M., & Sinatkas, J. (2020). Surveying undergraduate Greek student's knowledge on some issues of radiations and Nuclear Energy. arXiv preprint arXiv:2006.03549.

[14] Santos, J. V. L. (2022). Students'acceptance of nuclear power in the Philippines. NRCP Research Journal, 21(2), 41-70.

[15] Belmonte, Z. J. A., Prasetyo, Y. T., Benito, O. P., Liao, J. H., Susanto, K. C., Young, M. N., ... & Nadlifatin, R. (2023). The acceptance of nuclear energy as an alternative source of energy among Generation Z in the Philippines: An extended theory of planned behavior approach. Nuclear Engineering and Technology, 55(8), 3054-3070.

[16] Rimehaug, S., Kaat, A., Nordvik, J., Klokkerud, M., & Robinson, H. (2021). Psychometric properties of the PROMIS-57 questionnaire, Norwegian version. Quality of Life Research, 31, 269 - 280.

[17] Sexton, E., King-Kallimanis, B., Morgan, K., & McGee, H. (2014). Development of the Brief Ageing Perceptions Questionnaire (B-APQ): a confirmatory factor analysis approach to item reduction. BMC Geriatrics, 14, 44 - 44.

[18] Gibbons, C., Kenning, C., Coventry, P., Bee, P., Bundy, C., Fisher, L., & Bower, P. (2013). Development of a Multimorbidity Illness Perceptions Scale (MULTIPleS). PLoS ONE, 8.

[19] Borwein, S., Magistro, B., Loewen, P., Bonikowski, B., & Lee-Whiting, B. (2023). The Gender Gap in Attitudes Toward Workplace Technological Change. SSRN Electronic Journal.

[20] Putri, A., Pranata, O., & Sastria, E. (2024). Students Perception of Science and Technology in Science Learning: A Gender Comparative Study. Jurnal Pijar Mipa. Anderson, Ian. 2015. "Indigenous Pathways into the Professions." UNESCO Observatory Multi-Disciplinary Journal in the Arts 4(1): 1-35

[21] Dancey, C. P., & Reidy, J. (2007). Statistics without maths for psychology. Pearson education.