



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.524

Volume 14, Issue 1, January 2025

STEM Students' Work Ethic and Formation of Scientific Attitudes in a Science Curriculum

John Emmanuel A. Lozada, Kyla H. Villazana, Nicole B. Dice

Pre-Service Teacher, College of Teacher Education, Filamer Christian University, Roxas City, Capiz, Philippines

Pre-Service Teacher, College of Teacher Education, Filamer Christian University, Roxas City, Capiz, Philippines

Pre-Service Teacher, College of Teacher Education, Filamer Christian University, Roxas City, Capiz, Philippines

ABSTRACT: Cultivating a strong academic work ethic and promoting scientific attitudes in STEM students are essential objectives of a well-crafted science curriculum. These elements are crucial in preparing students for the challenges of scientific inquiry and their future careers. This survey-correlational research design aimed to determine the academic work ethic and formation of scientific attitudes of Grade 12 STEM students in a science curriculum for the school year 2023-2024. The respondents were 186 senior high school students. Data were collected using the standardized academic work ethic scale (AWE-S) and the standardized scientific attitudes scale (SAS) The independent variable of this study was students' academic work while the formation of scientific attitudes was the dependent variable. The statistical tools used were frequency count, mean, standard deviation, and Pearson r. The level of significance was set at 0.01 alpha. The findings of the study revealed that generally, the level of academic work ethic was high. The level of scientific attitudes was positive. There was a notable difference between their academic work ethic in a science curriculum. Ultimately, it was discovered that there was a substantial, positive interrelationship between Grade 12 STEM students' academic work ethic and scientific attitudes in a science curriculum.

KEYWORDS: Academic Work Ethic, Scientific Attitudes, STEM Students, Science Curriculum.

I. INTRODUCTION

The Philippines underwent a significant change in its education system, aiming to address several critical challenges in the country's educational system. The transition from the K-10 education curriculum to K-12 was primarily driven by the goal of aligning the Philippine educational system with international standards, making Filipino students more globally competitive [1]. The current education curriculum in the Philippines follows a K-12 structure that was started in 2012 and was regarded as a comprehensive reform of DepEd's basic education [2], which encompasses kindergarten through Grade 12. Senior High School (SHS) (Grades 11 and 12) is the most recently added level in the Philippines' education curriculum and offers diverse tracks such as the Technical Vocational Livelihood (TVL) track, the Arts and Design track, the Sports track, and the Academic track, in which Science, Technology, Engineering, and Mathematics (STEM) is included. The STEM track in the Philippines' senior high school curriculum integrates students into more complex mathematical and scientific concepts, to lay the groundwork for their future college degrees. Students develop problem-solving skills by participating in various projects and conducting research that requires them to apply scientific, technological, mathematical, and engineering concepts.

Additionally, the curriculum in STEM education is designed not just to impart knowledge but also to instill a set of values and attitudes that are integral to success in scientific endeavors. Work ethics is defined as the principles that guide an individual's conduct as well as a personal set of acceptable workplace practices [3]. It also has a direct impact on how someone approaches their daily activities since it is driven by their love and enjoyment of their profession [4]. Implementing it into the curriculum can help students be better prepared for the workplace by exhibiting traits such as punctuality, dependability, and a commitment to high-quality work, making them appealing candidates for employers in STEM industries. It can also help students develop the mindset and skills necessary for success in their academic journeys and future contributions to the scientific community. However, the lack of studies conducted on this topic leads to a limited understanding of how these attributes are developed and nurtured within the context of a science curriculum, despite the recognized importance of academic work ethics and scientific attitudes.

This study aimed to investigate the Grade 12 STEM students' work ethic and formation of scientific attitudes in a science curriculum at Filamer Christian University for the school year 2023-2024. Specifically, this study sought to answer the following questions:

1. What is the level of STEM students' academic work ethic in a science curriculum as an entire group and in terms of; hard work, leisure, self-reliance, morality/ethics, and delay of gratification?
2. What is the level of STEM students' scientific attitudes in a science curriculum as an entire group and in terms of; rationality, open-mindedness, confidence in scientific method, curiosity, and aversion to superstition?
3. Are there significant differences between the levels of STEM students' scientific attitudes and academic work ethic in a science curriculum?
4. Are there significant relationships between the levels of STEM students' academic work ethic and scientific attitudes in a science curriculum?

II. RELATED LITERATURE

Work ethic is broadly defined by [5] as a set of beliefs, values, and behaviors reflecting an individual's dedication and commitment to work, involving going beyond basic job requirements to achieve goals aligned with norms and values. [6] emphasizes that work ethic prioritizes hard work and diligence, aligning with societal ideals such as the "American Dream," which connects effort with success and social mobility.

This definition is expanded by [7] suggesting that work ethic includes valuing hard work, stigmatizing idleness, fulfilling obligations, and treating work as a moral duty. [7] outline seven dimensions of work ethic: belief in hard work, centrality of work, time efficiency, distaste for leisure, delayed gratification, independence, and morality in work. Together, these dimensions form a structured foundation, with work as a central value that requires consistent effort, honest conduct, and careful time management.

According to [8] work ethic frames schoolwork as a student's "job," indicating that a strong work ethic is critical to academic success. [10] further emphasize that students with a strong work ethic exhibit habits like consistent study, responsibility, and dedication, which lead to higher academic achievement. [11] introduce the concept of "work drive," a motivation to complete tasks and achieve success. This construct uniquely predicts academic outcomes in college beyond cognitive abilities, showing the importance of intrinsic motivation. [12] developed the Academic Work Ethic-Student (AWE-S) measure, grounded in the multidimensional work ethic profile (MWEP), to assess schoolwork-related ethics in middle and high school students. This tool provides a reliable, age-appropriate assessment of students' work ethic, capturing seven MWEP dimensions relevant to academic settings.

Early development of work ethic is crucial, as [13] suggests, with debates on whether younger generations are experiencing a decline in work ethic or simply adapting it to modern values. Family influence plays a pivotal role, with values like discipline, hard work, and responsibility being instilled by parents to foster strong work ethics [14] [15] identify indicators of hard work—achieving goals, persistence, and resilience—that are essential in character education and contribute to building a robust work ethic. Additionally, [16] describes hard work as a proactive approach to overcoming obstacles, underscoring the necessity of perseverance to navigate challenges.

Scientific attitude is described as a mindset involving consistency, objectivity, and rationality in problematic situations, contributing to students' approach to learning science. Those with scientific attitudes are likely to think, act, and exhibit attitudes similar to scientists, favoring systematic and evidence-based approaches [17] [18] note that individuals with a scientific attitude approach problems through systematic and experimentally verified steps. This attitude promotes active and creative learning and often correlates with high academic achievement. [19] highlight that scientific attitudes involve stable tendencies in students to perceive objects based on personal beliefs and responses, including cognitive, affective, and behavioral elements.

According to [20] scientific attitude includes curiosity, honesty, open-mindedness, critical thinking, and respect for data and facts. [21] add that these attitudes enable students to interpret experiences with critical thinking and express their opinions. Scientific attitudes incorporate perseverance, cooperation, and sensitivity to environmental changes, which upgrade students' learning quality [22][23][24] emphasize that scientific attitudes foster curiosity and critical thinking, motivating students to question and explore new ideas.

As stated in [25] scientific attitudes help students become open to new facts and avoid premature conclusions without evidence. This openness to learning and evidence-based reasoning improves students' judgment and critical thinking skills [26]. Literature shows that a well-managed learning environment positively influences students' scientific attitudes [27]. Students maintain positive scientific attitudes; they are more likely to succeed academically and professionally. Teaching methods also play a role in shaping scientific attitudes. [28]

Scientific attitudes align with the core goals of science education, emphasizing hands-on exploration, critical reasoning, and objective assessments. Enhancing scientific attitudes can lead to improvements in scientific literacy, as these attitudes embody habits of mind essential for scientific inquiry [29]. Studies highlight the necessity of embedding scientific attitudes within the curriculum. Instruments like open-inquiry learning models have been used to assess and improve students' scientific attitudes [30]. Problem-based learning is effective in enhancing students' scientific attitudes by encouraging structured, scientific exploration [31]. In their study, [32] investigated scientific attitude in secondary students, concluding that scientific attitude is linked with cognitive development, helping students analyze, question, and approach learning critically.

According to research by [33], government school students often demonstrate high scientific attitudes, which supports their learning in science and other subjects. Findings from [32] suggest that secondary school students' scientific attitudes are generally average, regardless of gender, indicating room for improvement in science education practices to foster these attitudes. [34] found a positive correlation between students' scientific knowledge and their attitudes toward science, showing that increased understanding fosters positive attitudes.

III. METHODOLOGY

This research utilized a survey-correlational approach involving 186 STEM students selected through stratified random sampling. The study employed Slovin's formula to determine the sample size. Data collection included an academic work ethic scale (AWE-S) adopted from [9]. And scientific attitudes scale (SAS) was adopted from [35]. Pilot testing followed validation, providing data for factor analysis, construct validation, and reliability testing using SPSS software. The independent variable was the effectiveness of the vision, mission, and goals while the dependent variable was the personal and professional development of the preservice teachers. Data analysis included descriptive statistics (frequency, mean, standard deviation) and inferential statistics (ANOVA, Pearson correlation coefficient), with a significance level (alpha) set at 0.01.

IV. RESULTS AND DISCUSSION

A. Level of Academic Work Ethic

The level of academic work ethic of Grade 12 STEM students as an entire group and in terms of; hard work, leisure, self-reliance, morality/ethics, and delay of gratification are shown in Table 1. Data show that generally, the level of work ethic is high. (M = 3.96, SD = .38). Data also show that levels of leisure; (M = 3.84, SD= .69), self-reliance, (M = 4.01, SD = .65), morality/ethics, (M = 3.57, SD= .59), and delay of gratification (M = 4.11, SD= .63) are high. On the other hand, hard work is very high. (M = 4.28, SD = .49).

Table 1: Mean and Standard Deviation of Academic Work Ethic of STEM Students

Category	Mean	Description	.SD
Academic Work Ethic	3.96	High	.38
Hard Work	4.28	Very High	.49
Leisure	3.84	High	.69
Self-Reliance	4.01	High	.65
Morality/Ethics	3.57	High	.59
Delay of Gratification	4.11	High	.63

Note Interval. 4.21–5.00: Very High, 3.41–4.20: High, 2.61–3.40: Moderate, 1.81–2.60: Low, and 1.00–1.80: Very Low

The work ethic of Grade 12 STEM students is high. This implies that STEM students work diligently and have demonstrated a commitment to their academic duties and tasks. This high level of work ethic characterizes a very disciplined approach toward achieving goals, where individuals put forth hard work, respect in leisure time, self-reliance, possess high moral values, and can delay gratification. They may be able to bring in increased productivity, reliability, and success within various genres because such a person would in all probability approach tasks with determination and feelings of duty. Such commitment will spur good habits and dispositions like time management, attention to detail, and a 'can-do' attitude—key to any long-term success. The reason for this is that STEM students often face rigorous academic demands that require persistence, self-discipline, and a structured approach to succeed.

There is a very high level of hard work. This implies that STEM students are exceptionally diligent and dedicated to putting in the effort to carry out tasks required to achieve their goals. They may be able to commit to dedication which will sometimes result in productivity and a capability to stay on even the most difficult of tasks, persisting and remaining resilient. Those with very high levels of hard work will do very well in environments where persistence and endurance are required. It could be one of the major drivers of long-term success because persons with this type of personality will be better positioned to overcome difficulties, hit deadlines, and realize goals. They may be able to, however, reflect on possible burnout if such a high level of hard work is not counterbalanced by appropriate rest and leisure. This implication arises because STEM disciplines have strict requirements that demand immense perseverance and commitment in honing skills, most of which take on the learner to succeed in challenging environments and sustainable achievements.

The level of leisure of Grade 12 STEM students is high. This implies that they attach importance to and involve themselves in recreational activities and relaxation. It is a significant element in maintaining the balance of life. They may be able to link mental and emotional well-being by creating an opportunity for breaks and doing things a person loves, thus reducing the levels of stress that have been accumulating, avoiding burnout, and increasing happiness. This balance may be able to also make them creative and productive, as time off for leisure might give people a chance to come back with renewed energy and clearer views of things. High leisure may result in very high levels of leisure, thus interfering with responsibilities and productivity; therefore, it has to be avoided. If managed properly, high leisure is likely to complement work effort through the restoration of health and the savviness of motivation. This is because adding leisure time allows one to recharge, serving productivity and creativity and thus having a balanced approach toward the demanding STEM studies.

The level of self-reliance of Grade 12 STEM students is high. This implies that students can work independently and make decisions on their own while solving problems without depending too much on others (classmates, friends, teachers, etc.) This often leads to improved academic performance since self-reliant students will usually take the initiative, use their time well, and look for resources and solutions by themselves. They may be able to enhance a sense of ownership over the learning process; where it encourages the setting and pursuing of personal goals and adapting strategies to master challenges. They are usually more resilient when things go tough and more capable of dealing with complex tasks and projects. This happens because it establishes independence and self-reliance, giving students a sense of having control over how they learn and the means to seek solutions proactively. STEM students who are self-reliant are often more resilient and resourceful, equipping them to tackle complex tasks effectively.

The level of morality/ethics of Grade 12 STEM students is high. This implies that STEM students adhere to the principles and values of ethics. They may devote themselves to the integrity, honesty, and responsibility of their academic task, which forms a core component of the credibility and reliability of their academic endeavors. They may be able to act conscientiously—avoiding academic cheating—and pave ways for their work to get checked and guided by ethical standards making them self-dependent as well. Furthering a healthy, encouraging atmosphere in both academics and personal life. They may be able to build trust and respect—ingredients needed for close collaboration and progress within the STEM community. This translates into honesty and responsibility in STEM fields concerning responsible research and collaboration. High ethical standards build students up to eventually have a reputation for being reliable, thus providing an excellent base for success in both academic and professional settings.

The level of delay of gratification is high. This implies that STEM students can delay immediate rewards in favor of more long-term objectives of higher priority. The ability to hold one's immediate gratifications off for something greater in the near or far future is highly regarded as a predictor for success, be it within the school gates, establishing oneself in a career, or simply growing older and developing as an individual. Moreover, highly delaying persons are

much more likely to handle time and other resources wisely with proper priorities in place and avoid impulsive actions that may hamper their long-term goals. This self-control can facilitate better decision-making and planning. This is important because it means that practicing self-control and orientation toward delayed reward is an instrumental ability to attain complex educational and professional goals. Students in the STEM disciplines, who develop this capability, tend to be better at prioritizing, making better use of resources, and making choices that align with long-term objectives.

B. Level of Scientific Attitudes

The level of scientific attitudes of STEM students as an entire group and in terms of; rationality, open-mindedness, confidence in scientific method, curiosity, and aversion to superstition are presented in Table 2. The results show that in its entirety, the level of scientific attitudes is positive ($M = 3.57$, $SD = .78$). Data also presented that the levels of rationality; ($M = 3.63$, $SD = .37$), confidence in scientific method, ($M = 3.89$, $SD = .65$), and curiosity ($M = 3.85$, $SD = .59$) are positive. Meanwhile, open-mindedness, ($M = 3.31$, $SD = .69$), and aversion to superstition ($M = 3.19$, $SD = .63$) are neutral.

Table 2: Mean and Standard Deviation of Scientific Attitudes of STEM Students

Category	Mean	Description	.SD
Scientific Attitudes	3.57	Positive	.78
Rationality	3.63	Positive	.37
Open-Mindedness	3.31	Neutral	.69
Confidence in Sci. Method	3.89	Positive	.65
Curiosity	3.85	Positive	.59
Aversion to Superstition	3.19	Neutral	.63

Note Interval. 4.21–5.00: Very High, 3.41–4.20: High, 2.61–3.40: Moderate, 1.81–2.60: Low, and 1.00–1.80: Very Low
The level of scientific attitudes of STEM students is positive. This implies that they were able to cultivate an environment where they are motivated to investigate and question their surroundings, establishing a sustained enthusiasm for learning in the fields of sciences. Such attitudes underlie a strong scientific outlook: that of a self-assured student ready to challenge any phenomenon through reasoning, open up to new ideas, test hypotheses most stringently, and reject the unscientific. Pedagogical practices for inculcating such traits have increased the potential for students to make significant contributions to the advancement of science and technology.

The level of rationality of STEM students is positive. This implies that students are ripe enough to solve problems logically and make decisions based on evidence and reason. It would mean that critical and analytic thinking skills programs do have a positive input toward the development of rational thought and hence extremely important for success in STEM. Focusing on rationality, STEM education can thus more suitably position the student to be better prepared for facing challenges and adversities, innovating, and contributing to the building of science and technology.

The level of STEM students' open-mindedness is neutral. This implies that though they may be somewhat open to new ideas, they can also turn out to be resistant to contrary opinions. This means that such common practices in the school curriculum may not after all justify the nurturing of acceptance of diverse perspectives or the development of creative thought among students. For a person to become open-minded, educators have to include activities and talks that will facilitate intellectual flexibility, hence the inclination towards the consideration of different viewpoints. There is the likelihood of such open-mindedness following a STEM student's eventual ability to become innovative and collaborative in fixing ill-structured problems.

The level of confidence in the scientific method of STEM students is positive. This implies that they are applying the scientific method to approaching challenges with great belief and some soundness in full research. This insinuates that these students, being able to inculcate strong understandings and beliefs in the scientific process, are better placed to undertake wide research, think critically about data, and apply scientific principles to their different disciplines. This kind of confidence needs to be further built and sustained to nurture scientific knowledge and develop a culture of evidence-based problem-solving in STEM.

The level of curiosity of STEM students is positive. This implies that they have a strong drive to explore, question, and learn new things. They possess the intrinsic motivation to somehow look deeper into the understanding of scientific phenomena and problems, looking for innovative solutions. If properly transmitted and developed, such curiosity could even enhance potential in problem-solving and discoverability. Educational strategies must, however, still provide an environment that is challenging and inspiring to learners for them to go out in the exploration and investigation of new ideas.

The level of aversion to the superstition of STEM students is neutral. This implies that while they may recognize and reject some unscientific beliefs, there may be room for improvement in fostering a stronger critical perspective. This suggests that current educational approaches might not fully emphasize the importance of distinguishing between scientific evidence and superstition. To address this, educational strategies could focus on reinforcing critical thinking and the scientific method, helping students more clearly differentiate between empirical evidence and unscientific beliefs, thereby strengthening their overall scientific mindset.

C. Differences between the Scientific Attitudes Based on the Work Ethic of STEM Students

The differences in the scientific attitudes based on the work ethic of STEM students are shown in Table 3. Table 3 shows that there is a significant difference in the scientific attitudes based on the work ethic of STEM students $F(9.499) = .000, p < 0.01$ in favor of the very high (4.21-5.00) work ethic ($M = 3.68$ $SD = .32$)

Table 3: ANOVA on the Differences in the Scientific Attitudes Based on Work Ethic of STEM Students

Category	Sum of Squares	Df	Mean Square	F	Sig. (2-tailed)
Academic Work Ethic					
Between Groups	2.091	2	1.046	9.499	.000
Within Groups	20.249	183	.111		
Total	22.340	185			

ns $p > .05$ – not significant at 5% level

The level of scientific attitudes of STEM students varies significantly based on their work ethic. This implies that those who are more diligent and disciplined in their studies tend to develop a deeper connection with scientific thinking. This relationship hints that a strong work ethic could be central to how students engage with scientific concepts and methods. Encouraging perseverance, responsibility, and a dedicated approach to learning might play a crucial role in shaping students' positive attitudes toward science, potentially paving the way for greater achievements and innovations in STEM areas.

D. Relationships between Work Ethic and Scientific Attitudes of STEM Students

The relationships between work ethic and scientific attitudes of STEM students are presented in Table 5. Data reveal that there is a positive, strong association, and significant relationship between the work ethic $r = .322^*, p = .000 < .01$ and the scientific attitudes of STEM students. Therefore, the null hypothesis is rejected.

Table 4: Pearson r between Academic Work Ethic and Scientific Attitudes of STEM Students

Variables	r-value	r-prob
Academic Work Ethic and Scientific Attitudes	.322*	.000

* $p < .05$ – significant at 5% level

The result shows that there is a positive, strong association, and significant relationship between the work ethic and scientific attitudes of STEM students. This implies that developing a positive attitude in the student is going to bring about a strong work ethic, and vice versa. When students are inspired to take on anything they pursue with a great, positive perspective, they usually become more motivated, devoted, and consistent in their efforts. That generally translates to better results and more toughness in the face of failures or other setbacks. The infusion of desirable

attitudes toward working in students would be perceived to be of great importance by any teacher who may bring them long-term growth and accomplishment.

V. CONCLUSIONS

The high academic work ethic in the STEM students reflects a strong work ethic that correlates well with the diligent and rigorous pursuit of education. Such an attitude involves a well-disciplined attitude toward labor, a well-regulated attitude toward leisure, and sound self-governance. These learners thus tend to demonstrate a capacity for delaying immediate gratification in favor of long-term academic goals tenet akin to perseverance and moral integrity. Such commitment serves to underscore the importance of integration between character development and intellectual growth in a program that emphasizes both ethical conduct and academic effort in realizing holistic student success.

These dominant positive science attitudes among STEM students will form a base and backdrop of rational, open-minded, and confident thinking about scientific methodologies. Otherwise, such students often bear more heightened curiosity in the pursuit of knowledge with a strong discard of superstition, which will reasonably enable them to criticize problems and look at issues from an evidence-based viewpoint. These attributes enable not just a better understanding and appreciation for scientific principles but also prepare them to responsibly and thoughtfully contribute to the advancement of science and technology within society.

The significant differences found regarding STEM students' scientific attitudes further underscore the need for targeted strategies in the curriculum for science. Such differences indicate that focusing on scientific attitudes and work ethic as two different yet complementary strands should prove beneficial in maximizing the performance and interest in science. Educators could therefore craft more inclusive and effective curricula to help meet the different needs of learning as well as career pursuits of STEM students by tailoring interventions to both improving the aspects.

This interplay between work ethic and scientific attitudes shows how close is the relationship between values and behaviors in a science curriculum: growth in one often engenders growth in the other. This is evident in that, as students' engagement with science learning becomes better, they come to exhibit higher commitment and responsibility, illustrating the mutual reinforcement of work habits and attitudes. These results provide support for the reality of educational practices whereby not only are these measures nourished but also a more effective, reflective, and engaged learning process that is geared toward making STEM students well-fitted for the multiple requirements.

REFERENCES

- [1] Oxford Business Group. (2022). Education reform in the Philippines aims for better quality and more access - Asia 2017 - Oxford Business Group. Oxford Business Group. <https://oxfordbusinessgroup.com/reports/philippines/2017-report/economy/a-thorough-examination-substantial-reform-has-brought-with-it-a-variety-of-challenges>.
- [2] Okabe, M. (2013). Where does Philippine education go?: the "K to 12" program and reform of Philippine basic education. Institute of Developing Economies (IDE-JETRO). <http://hdl.handle.net/2344/1267>.
- [3] Andreev, I. (2023). Work ethic in the workplace. Valamis. <https://www.valamis.com/hub/work-ethic>.
- [4] Porter and Chester Institute [PCI]. (2014). Importance of good work ethics in school and life. Porter and Chester. Institute. <https://porterchester.edu/news-events/importance-good-work-ethic-school-life>.
- [5] Meriac, J. P., Thomas, A. L. E., & Milunski, M. (2015). Work ethic as a predictor of task persistence and intensity. *Learning and Individual Differences*, 37, 249–254. <https://doi.org/10.1016/j.lindif.2014.11.006>.
- [6] American Heritage. (2013). *The American Heritage Dictionary of the English Language*, 5th Edition, Houghton Mifflin Harcourt: Boston, MA.
- [7] Grabowski D et al. (2015) (WPEP). Charakterystyka psychometryczna polskiej wersji kwestionariusza Multidimensional Work Ethic Profile. [Wielowymiarowy profil etyki pracy (WPEP). Psychometric properties of the Polish version of the multidimensional work ethic profile]. *Psychologia Społeczna*.
- [8] Grabowski D (2015). Etyka pracy. Przekonania wartościujące pracę a zaangażowanie pracowniko'w. [Work Ethic. Work Evaluating Convictions and the Commitment of Workers]. Katowice: Wydawnictwo Uniwersytetu Śląskiego;
- [9] Taylor, E. (2016). Academic Work Ethic in Middle School Students: Extending Scale Academic Work Ethic in Middle School Students: Extending Scale Research and Investigating Construct Validity Research and Investigating Construct Validity.

- [10] Meriac, John P., et al. (2015) "Work Ethic as a Predictor of Task Persistence and Intensity." *Learning and Individual Differences*, vol. 37, pp. 249–254, <https://doi.org/10.1016/j.lindif.2014.11.006>.
- [11] Lounsbury (as cited in Taylor, Emily 2016). *Academic Work Ethic in Middle School Students: Extending Scale Academic Work Ethic in Middle School Students: Extending Scale Research and Investigating Construct Validity Research and Investigating Construct Validity*.
- [12] Parkhurst (as cited in Taylor, Emily 2016). *Academic Work Ethic in Middle School Students: Extending Scale Academic Work Ethic in Middle School Students: Extending Scale Research and Investigating Construct Validity Research and Investigating Construct Validity*.
- [13] Chen, K. Y. (2014). What American educators can learn from Chinese secondary education? *American Secondary Education*, 42(2), 69–79.
- [14] Hasan (as cited in Riza Perdana 2019). *Pengembangan pendidikan budaya dankarakter bangsa*. <https:// Kemendiknas>.
- [15] Daryanto & Darmitan, S. (2013). *Pendidikan karakter di sekolah*. Yogyakarta :Gadjah Mada University press.
- [16] Gunawan (as cited in Yusi Aviando et. al, 2019), *pendidikan karakter konsepe dan implementasi*. badung: Alfabeta.
- [17] R Ergul, Y Simsekli, S Calis, Z Ozdilek, S Gocmencelebi and M Sanli (2011), *The Effect of Inquiry-Based Science Teaching on Elementary School Students' Science Process Skills and Science Attitudes*, *Bulgarian Journal of Science and Education Policy, Bulgaria*, pp. 48- 68.
- [18] Revati, N., & Meera, D. K. P. (2017). An Investigation of Scientific Attitude among Secondary School Students in Kottayam District of Kerala. *IOSR Journal of Research & Method in Education (IOSRJRME)*, 7(1), 63–66. <https://doi.org/10.9790/7388-0701036366>.
- [19] Brown et al (2015). "The Impact of Research-Oriented Collaborative Inquiry Learning on Pre-Service Teachers' Scientific Process Skills and Scientific Attitudes." *Journal of Technology and Science Education*, vol. 12, no. 2, 2022, pp. 410–425, www.jotse.org/index.php/jotse/article/view/1583/624.
- [20] Astalini, A., Kurniawan, D. A., & Nurfarida, L. Z. (2018). Deskripsi sikap siswa SMA di Batanghari berdasarkan indikator normalitas ilmuwan, adopsi dari sikap ilmiah, ketertarikan memperbanyak waktu, dan ketertarikan berkarir di bidang fisika. *Jurnal Riset dan Kajian Pendidikan Fisika*, 5(2), 73. <https://doi.org/10.12928/jrpkpf.v5i2.10736>.
- [21] Anggraini, L Astalini, A., Kurniawan, D. A., & Kurniawan, N. (2019). Evaluation of Student's Attitude Toward Science in Indonesia. *Open Journal for Educational Research*, 3(1), 1–12. <https://doi.org/10.32591/coas.ojer.0301.01001a>.
- [22] Rini Budiharti, and N S Warasn (2018). "Analysis of Student's Scientific Attitude Behaviour Change Effects Blended Learning Supported by I-Spring Suite 8 Application." *Journal of Physics*, <https://doi.org/10.1088/1742-6596/1022/1/012024>.
- [23] Arseculeratne, S. (2014). The scientific attitude (the scientific temper) in Eastern and Western societies. *Anuradhapura Medical Journal*, 8(1), 22. <https://doi.org/10.4038/amj.v8i1.6757>.
- [24] Strauss, *The Scientific Attitude*. (2016). Typeset.io. <https://typeset.io/papers/the-scientific-attitude-36ylafzsg>.
- [25] Rohaeti, E., Prodjosantoso, A. K., & Irwanto. (2020). Research-oriented collaborative inquiry learning model: Improving students' scientific attitudes in general chemistry. *Journal of Baltic Science Education*, 19(1), 108–120. <https://doi.org/10.33225/jbse/20.19.108>.
- [26] Devi, M. G., & Aznam, N. (2019). The effect of science-technology-society (STS) model on scientific literacy and scientific attitude of students on the subject of buffer. *Journal of Physics: Conference Series*, 1156(1). <https://doi.org/10.1088/1742-6596/1156/1/012027>.
- [27] Raved, Lena, and Orit Ben Zvi Assaraf. (2011) "Attitudes towards Science Learning among 10th-Grade Students: A Qualitative Look." *International Journal of Science Education*, vol. 33, no. 2010, pp. 1219–1243, <https://doi.org/10.1080/09500693.2010.508503>.
- [28] Aydeniz, and Kotowski. (2014) "Conceptual and Methodological Issues in the Measurement of Attitudes towards Science." *Electronic Journal of Science Education*, vol. 18, no. 3, 2014, files.eric.ed.gov/fulltext/EJ1188279.pdf. Accessed 15 Nov. 2024.
- [29] Spektor-Levy, O., Baruch, Y. K., & Mevarech, Z. (2013). Science and Scientific Curiosity in Pre-school—The teacher's point of view. *International Journal of Science Education*, 35(13), 2226–2253. <https://doi.org/10.1080/09500693.2011.631608> Spektor-Levy, O., Baruch, Y. K.
- [30] Widowati, A., et al. (2018) "Applying Innovative Approach "Nature of Science (NoS) within Inquiry" for Developing Scientific Literacy in the Student Worksheet." *Journal of Physics: Conference Series*, vol. 983, p. 012199, <https://doi.org/10.1088/1742-6596/983/1/012199>.
- [31] Sakliressy, M. T., Sunarno, W., & Nurosyid, F. (2021). Students' scientific attitude in learning physics using problembased learning model with experimental and project methods. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, 10(1), 59–70. <https://doi.org/10.24042/jipfalbiruni.v10i1.8347>

- [32] Marlow (as cited in Sundaravalli, D. S. R., & Kumari, G. K. S. 2022). Scientific Attitude – An Overview. *Psychology and Education Journal*, 59(1), 150–158. <http://psychologyandeducation.net/pae/index.php/pae/article/view/7111>
- [33] Raja, V. (2016). Scientific attitude among secondary school students. *An International Referred, Indexed & Peer Reviewed Bi-Annual Journal in Education*, 3(1), 133–134. <https://doi.org/10.22183/23501081>
- [34] Uzun (as cited in AlAli et al., (2024) “Young Children’s Attitudes toward Science Learning in Early Learning Grades.” *Asian Education and Development Studies*,. [sciedirect.com/org/science/article/pii/S2046316224000166#bref013](https://doi.org/10.1108/aeds-02-2024-0036), <https://doi.org/10.1108/aeds-02-2024-0036>.
- [35] Khan, M., & Siddiqui, M. A. (2020). Examining scientific attitude scales in India: Development and validation of a new scale. *Interdisciplinary Journal of Environmental and Science Education*, 16(4), e2223. <https://doi.org/10.29333/ijese/8557>.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details