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Original Article

The Mediating Effect of Epistemic Curiosity Between Perceived Critical Thinking Disposition and Research Competence of Senior High School Students Under Education 4.0

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Abstract. Epistemic curiosity is increasingly recognized as a key factor in students' learning engagement. However, its role in supporting critical thinking and research competence among senior high school students remains poorly established. This study examined the relationships among epistemic curiosity, perceived critical thinking disposition, and research competence, with particular focus on the mediating effect of curiosity. Quantitative, non-experimental, descriptive–correlational methods were employed, utilizing data from 144 students via adopted survey questionnaires. Correlational analyses indicated no significant relationships among the three variables. Mediation analysis using the Sobel z-test revealed that epistemic curiosity did not significantly mediate the association between critical thinking disposition and research competence. These findings suggest that while students may exhibit high levels of curiosity and cognitive ability, these attributes do not necessarily result in enhanced research skills. The study emphasizes the need for interventions that combine curiosity-driven approaches with explicit instruction in metacognition, research methods, and self-regulated learning. ***Project QUEST*** is proposed as an intervention to enhance research competence among senior high school students while maintaining curiosity and engagement.

Keywords: *Critical thinking disposition; Education 4.0; Epistemic curiosity; Research competence; Mediation.*

The shift to Education 4.0, emphasizing digital integration and higher-order thinking, requires senior high school students to engage in inquiry and knowledge construction actively. However, many still rely on memorization, reflecting low epistemic curiosity and limited motivation to seek and understand new information. This lack reduces reflective reasoning and weakens research competence, especially in problem conceptualization, methodology, and data interpretation. Notably, studies indicate that the critical thinking disposition is often moderate to low and is associated with insufficient motivation for inquiry (Aditya et al., 2023). Furthermore, epistemic curiosity supports analytical engagement and knowledge-seeking (Fahruddin et al., 2022) and strengthens research competence by encouraging sustained inquiry and critical evaluation (Alzate, 2025).

In the global context, gaps persist in the development of curiosity-driven inquiry and higher-order thinking. For instance, in Japan, students gradually improved, but their initial levels of inquiry and critical thinking were low,

indicating the need for sustained instructional support (Kusumi, 2025). Similarly, in Malaysia, curriculum reforms aimed at promoting critical thinking did not yield significant improvements in student outcomes (Khairuddin et al., 2024). Likewise, in Peru, student performance remained at low to moderate levels (Cárdenas et al., 2021). In Indonesia, students' 4C skills continued to lag, despite curricula being aligned with the requirements of the Fourth Industrial Revolution (Sari et al., 2025). Meanwhile, although curiosity-driven learning has gained attention in Thailand, many classrooms still emphasize content coverage over inquiry and exploration (Nakamura et al., 2022). More broadly, global studies show that educational systems struggle to balance technological advancement with pedagogies that promote higher-order thinking (OECD, 2024).

In the Philippines, similar challenges have been documented. Senior high school students demonstrate only moderate levels of critical thinking and uneven research competence across schools and districts (Pilande, 2023). Similarly, Servado (2024) found that Filipino learners have average research capabilities, suggesting a limited tendency to engage in sustained inquiry and analytical thinking. Although Practical Research 1 and Practical Research 2 are included in the senior high school curriculum, many students continue to struggle to conceptualize research problems and construct coherent problem statements. Moreover, evidence from school-based studies indicates that senior high school students find developing a research problem particularly challenging, often lacking the skills to formulate a clear and focused research question (Samante, 2023). In addition, studies on research writing in senior high school show that students perceive writing a research paper as tedious and complex, with specific challenges in providing appropriate research problems and constructing questionnaires, reflecting gaps in procedural understanding and competence (Habungan, 2019). Finally, classroom observations and teacher reports further indicate that students often lack confidence in research writing, exhibiting low motivation and passivity when assigned research tasks, suggesting that limited exposure to research processes and low writing efficacy hinder students' engagement in independent inquiry (Paurillo, 2019; Bastida & Saysi, 2023).

In the Davao Region, local studies likewise reveal persistent challenges. For example, teachers reported ongoing weaknesses in students' research and writing skills, prompting the use of mentoring programs and instructional video lessons as interventions (Pinuto, 2024). Similarly, research on teaching competence and self-regulated learning suggests that research competence among senior high school learners in the region continues to require focused attention (Luna & Ballado, 2025). Despite the integration of Education 4.0 principles, many students still struggle with the early stages of research, particularly in conceptualizing and refining researchable ideas. These findings indicated a clear research gap. While existing studies have examined critical thinking and research competence, very few have investigated how epistemic curiosity may mediate between these constructs, particularly among senior high school students. In the context of Education 4.0, curiosity, inquiry, and innovation are essential foundations of academic and professional success. This emphasis is further highlighted by its alignment with Sustainable Development Goal 4 on Quality Education, which promotes the development of critical thinking, creativity, and research-oriented competencies. Therefore, by examining the mediating role of epistemic curiosity, this study aimed to generate evidence on how cognitive and motivational factors interact to influence research competence, thereby informing curriculum design, teacher preparation, and learner support systems.

Methodology

Research Design

The researchers employed a quantitative, non-experimental design, specifically a descriptive-correlational approach, to examine the relationships among perceived critical thinking disposition, epistemic curiosity, and research competence among senior high school students in the context of Education 4.0. This design allowed the researchers to describe the levels of each variable and determine naturally occurring relationships without manipulation (Sousa et al., 2007). Mediation analysis using regression procedures was employed to test the mediating effect of epistemic curiosity, with perceived critical thinking disposition as the independent variable and research competence as the dependent variable, thereby identifying both direct and indirect effects. The study was quantitative because it involved numerical data collected through standardized Likert-scale instruments and was non-experimental, as the variables were observed as they occurred, to describe patterns and test mediation rather than establish causality.

Participants and Sampling Technique

The study targeted all 144 Grade 12 students, comprising 91 from the Academic Track and 53 from the Technical-

Vocational-Livelihood (TVL) Track, and employed complete enumeration to ensure full representation and minimize sampling error. These students were considered appropriate respondents because they had already completed Practical Research 1 and 2, which had equipped them with skills in formulating problems, collecting and analyzing data, and engaging in digital-based inquiry aligned with Education 4.0. The inclusion criteria required that respondents were officially enrolled as Grade 12 students, belonged to either the Academic or TVL Track, had completed both Practical Research 1 and 2, and voluntarily agreed to participate by providing informed consent. The exclusion criteria excluded individuals who were not officially enrolled during the study period, who were absent during data collection, who were unable to complete the instrument, or who belonged to tracks not included in the study. The research was conducted in a public secondary school in Kiblawan South District, Davao del Sur, a rural area with limited access to technological resources, making the site appropriate for examining research competence and conceptual understanding within the context of Education 4.0.

Research Instrument

The primary data-gathering tool used in the study was an adapted survey questionnaire designed to measure perceived critical-thinking disposition, epistemic curiosity, and research competence. The instrument was validated by three experts: a Senior High School Master Teacher, a Research Coordinator, and a Junior High School Master Teacher, all selected for their research expertise. The questionnaire consisted of three parts: the first measured critical thinking using Sosu's (2013) Critical Thinking Disposition Scale with 11 items across Critical Openness and Reflective Skepticism subscales with reported reliability of $\alpha = 0.79$; the second measured epistemic curiosity through Litman's (2008) Epistemic Curiosity Questionnaire, composed of 10 items under Interest-type and Deprivation-type subscales with reliability of $\alpha = 0.83$; and the third assessed research competence through the 38-item Research Skills Scale of Lacson and Dejos (2022), covering Problem Conceptualization, Research Methods and Data Analysis, and Writing and Reporting Results, which demonstrated excellent reliability of $\alpha = 0.92$. All questionnaire items used a five-point Likert scale, following Pimentel (2010), with scores ranging from Very Low to Very High to ensure consistent analysis across all variables.

Table 1. *Likert Scale*

Numerical Value	Range of Mean Values	Interpretation
5	4.20 – 5.00	Very High
4	3.40 – 4.19	High
3	2.60 – 3.39	Moderate
3	1.80 – 2.59	Low
1	1.00 – 1.79	Very Low

Data Gathering Procedure

The researchers sought the approval of the school principal to conduct the study. Thereafter, the researchers met with the class advisers of the identified Grade 12 sections. During this meeting, the school principal's approved letters of permission were presented, and the advisers were briefed on the study's objectives, scope, and procedures. The advisers coordinated with the researchers to schedule the administration of the structured survey questionnaire and the collection of relevant student data. Ethical considerations were strictly observed throughout the data collection process, including securing informed consent from all respondents and ensuring confidentiality, anonymity, and data privacy. Participation was voluntary, and only students who were officially enrolled as Grade 12 learners for the Academic Year 2025–2026 and belonged to either the Academic or TVL Track were included. Students who did not meet these criteria or were unable to complete the instrument were excluded from the study. The survey was administered during face-to-face sessions, and students were given one to two hours to complete the instrument to allow ample time for thoughtful responses. After the questionnaires were completed, the researchers tallied, tabulated, and encoded the responses for analysis, covering the entire population of 144 Grade 12 students to ensure comprehensive representation and enhance the validity and reliability of the study's findings.

Data Analysis

The study utilized mean and standard deviation to determine the level of epistemic curiosity, perceived critical thinking disposition, and research competence of senior high school students in Education 4.0, including the subdomains of interest-type and deprivation-type curiosity, critical openness and reflective skepticism, as well as problem conceptualization, research methods and analysis, and writing and reporting results. Pearson's r was employed to assess the relationships among the variables, specifically examining the associations among epistemic

curiosity and perceived critical thinking disposition, perceived critical thinking disposition and research competence, and epistemic curiosity and research competence. Mediation analysis was applied to determine the mediating effect of epistemic curiosity on the relationship between perceived critical thinking disposition and research competence. The Sobel z-test was used to assess the significance of mediation.

Ethical Considerations

This study adhered to established ethical guidelines to protect the rights, dignity, and well-being of all respondents. Consistent with Tracy (2020) and the British Educational Research Association (BERA, 2020), participation was voluntary, with informed consent obtained after clearly explaining the study's purpose, procedures, potential risks, and the right to withdraw at any time without penalty. Confidentiality and anonymity were ensured by removing personal identifiers and storing data in a secure, password-protected system, in accordance with best practices recommended by Mertens and Wilson (2020). Access to the data was limited to the research team and used solely for academic purposes. To prevent coercion or undue influence, the study adhered to the ethical standards outlined by the American Psychological Association (APA, 2020). Survey instruments were designed to be clear and appropriate for students' cognitive and emotional capacities, consistent with Given (2020). Overall, the study upheld high ethical standards, ensuring respect, fairness, and integrity throughout the research process.

Results and Discussion

Level of Epistemic Curiosity Among Senior High School Students

Table 2 presents the level of epistemic curiosity among senior high school students. The results showed that senior high school students demonstrated a very high level of epistemic curiosity, as reflected in the overall mean for the Interest-Type dimension (M = 4.30, SD = .47) and the Deprivation-Type dimension (M = 4.31, SD = .46). The total mean (M = 4.31, SD = .47) indicated that students consistently exhibited a strong motivation to seek new knowledge, resolve uncertainties, and engage in deeper cognitive exploration. The high scores in the Interest Type suggest that students enjoyed exploring new ideas and learning about unfamiliar topics. In contrast, the high scores on the Deprivation Type indicate a strong commitment to addressing knowledge gaps through sustained effort. This combination reflects a comprehensive form of epistemic curiosity, involving both the pleasure of learning and the drive to solve complex problems.

Table 2. *Level of Epistemic Curiosity*

Indicators	Mean	SD	Interpretation
Interest Type			
I enjoy exploring new ideas.	4.26	.48	Very High
I enjoy learning about subjects that are unfamiliar to me.	4.36	.48	Very High
I find it fascinating to learn new information.	4.34	.48	Very High
When I learn something new, I like to find out more about it.	4.33	.47	Very High
I enjoy discussing abstract concepts.	4.33	.47	Very High
I spend hours on a problem because I cannot rest without an answer.	4.24	.43	Very High
Conceptual problems keep me awake thinking.	4.27	.49	Very High
Overall	**4.30**	**.47**	**Very High**
Deprivation Type			
I get frustrated if I cannot figure out a problem, so I work harder.	4.33	.47	Very High
I work intensely on problems that must be solved.	4.26	.44	Very High
I brood for a long time to solve a problem.	4.34	.48	Very High
Overall	**4.31**	**.46**	**Very High**
Grand Total	**4.31**	**.47**	**Very High**

These findings align with recent research highlighting the important role of epistemic curiosity in adolescent learning. For instance, Gruber and Fandakova (2021) reported that during adolescence, curiosity enhances memory and learning by activating neural systems involved in reward and information processing. Their review supports the notion that high levels of curiosity facilitate sustained engagement and improved retention of new information. Additionally, Mussel (2022) found that curiosity significantly predicted academic performance, underscoring its importance as a predictor of long-term learning success. Furthermore, Chen et al. (2024) found that curiosity positively influences learning outcomes, particularly when learners recognize knowledge gaps and apply metacognitive strategies. This suggests that the students' high epistemic curiosity observed in this study may have been accompanied by metacognitive engagement, further strengthening their learning. Vilhunen et al. (2021) also mentioned that epistemic curiosity correlated with improved post-test academic performance,

highlighting its beneficial role in real classroom settings.

Level of Perceived Critical Thinking Disposition Among Senior High School Students

Table 3 presents the overall level of perceived critical-thinking disposition among senior high school students. The findings indicated that respondents demonstrated a very high level of critical thinking, as reflected in the overall mean score for Critical Openness (M = 4.32, SD = .47). This suggests that students frequently engaged in behaviors that demonstrated openness to new ideas and a willingness to consider diverse viewpoints. Reflective Skepticism also showed a similarly high mean (*M* = 4.33, *SD* = .47), indicating that students carefully evaluated information and thoughtfully considered the implications of their decisions. The combined mean across both dimensions was very high (*M* = 4.33, *SD* = .47), indicating that students consistently exhibited a strong perceived disposition toward critical thinking across both areas. Their capacity to analyze information, question assumptions, and reflect on experiences appears well developed and is frequently applied in their academic environment.

Table 3. *Level of Critical Thinking Disposition*

Indicators	Mean	SD	Interpretation
Critical Openness			
I think about the bigger picture during a discussion.	4.30	.46	Very High
I often use new ideas to shape (modify) the way I do things.	4.30	.46	Very High
I use multiple sources to gather information.	4.30	.46	Very High
I am often seeking new ideas.	4.26	.48	Very High
I sometimes find a good argument that challenges some of my firmly held beliefs.	4.38	.49	Very High
It is important to understand other people's viewpoints on an issue.	4.33	.47	Very High
It is important to justify the choices I make.	4.36	.48	Very High
Overall	**4.32**	**.47**	**Very High**
Reflective Skepticism			
I often re-evaluate my experiences to learn from them.	4.28	.45	Very High
I usually check the credibility of the source of information before making judgments.	4.35	.48	Very High
I typically consider the broader implications of a decision before taking action.	4.33	.47	Very High
I often reflect on my actions to determine whether I could improve them.	4.35	.48	Very High
Overall	**4.33**	**.47**	**Very High**
Grand Total	**4.33**	**.47**	**Very High**

These findings are consistent with recent studies emphasizing the importance of critical thinking in education. For example, Farillon (2022) reported that Filipino senior high school students with strong critical thinking and scientific reasoning skills tended to achieve higher performance in science subjects. Similarly, Shahzadi and Saira (2022) found that a higher disposition toward critical thinking was associated with improved academic achievement among secondary students. Ramos (2018) observed that senior high school learners with advanced critical thinking skills generally performed better academically, highlighting the value of these skills for student success. Moreover, Cárdenas et al. (2021) emphasized that critical thinking is a complex cognitive ability cultivated through reflective and adaptable teaching methods. Selvarani and Saroja (2022) also established a positive correlation between critical thinking skills and academic achievement, reinforcing the role of these skills in fostering student engagement and learning outcomes.

Level of Research Competence Among Senior High School Students

Table 4 presents the mean analysis of research competence among senior high school students. As can be gleaned from the table, the problem conceptualization (*M*=4.32, *SD*=.47), Research Methods and Data Analysis (*M*=4.33, *SD*=.47), and Writing and Reporting of results (*M*=4.34, *SD*=.47) obtained a verbal interpretation of "Very High". The total mean for research competence (*M*=4.34, *SD*=.47) also received a "Very High" rating. This indicates that students demonstrated a very high level of research competence and were generally well equipped to conduct academic research tasks.

Recent studies provide strong support for these results. For example, Servado (2024) evaluated the scientific research skills of Grade 11 and 12 STEM students and found that they demonstrated a high level of proficiency in conducting inquiry-based research. Likewise, Muthaharoh and Sukarelawan (2023) reported improvements in high school students' research capabilities, including data collection, analysis, and interpretation, after participation in problem-based experiential learning projects. Furthermore, De Torres et al. (2022) investigated senior high school students' research writing skills in Batangas Province, showing that learners were generally competent in essential research tasks such as identifying problems, collecting data, and presenting findings, although some difficulties were noted. These findings indicate that senior high school students can develop strong

research competencies when engaged in well-designed learning experiences supported by effective instructional strategies.

Table 4. *Level of Research Competence*

Indicators	Mean	SD	Interpretation
Problem Conceptualization			
I can indicate the scope and delimitation of my research.	4.26	.44	Very High
If confronted with a question/problem, I view it as an opportunity to conduct research.	4.34	.48	Very High
I can identify and ask useful, challenging questions. I am always curious.	4.31	.47	Very High
I can formulate my research topic/problem based on related literature and other sources.	4.32	.47	Very High
I can write a research title.	4.28	.45	Very High
I can create a mind map or concept map of my research topic/problem.	4.33	.47	Very High
I can generate research questions based on the topic/problem.	4.42	.50	Very High
I can justify the reasons for conducting the research.	4.33	.47	Very High
I can gather information about my research topic through various means (e.g., electronic media, images, audio, and video).	4.35	.48	Very High
I can use the main ideas derived from the research to support my topic.	4.29	.46	Very High
I can combine the main ideas from one or more sources to form a new idea.	4.31	.47	Very High
I can observe and collect the data necessary to address my problem.	4.35	.48	Very High
Overall	**4.32**	**.47**	**Very High**
Research Methods and Data Analysis			
I adhere to ethical standards when writing related literature.	4.31	.46	Very High
I can identify and access appropriate bibliographical resources, archives, and other sources of relevant information (*including web-based resources, primary sources, and repositories*).	4.34	.48	Very High
I can assess the reliability, reputation, currency, authority, and relevance of sources.	4.33	.47	Very High
I can evaluate the content's accuracy by consulting other sources cited by the writer.	4.29	.46	Very High
When searching for information, I can arrange each item systematically.	4.37	.48	Very High
I can write my references in any citation and referencing formats or styles.	4.32	.47	Very High
I can formulate a conceptual framework for my research.	4.33	.47	Very High
I can plan and design the research process of a research topic.	4.37	.48	Very High
I can determine the appropriate research design or method for my research.	4.31	.47	Very High
I can justify the principles and experimental techniques used in my research.	4.26	.44	Very High
I can design or adapt a research instrument to collect the necessary data for my study.	4.23	.42	Very High
I understand and apply the relevant codes of conduct and guidelines for the ethical conduct of research; I seek advice from my supervisor.	4.37	.48	Very High
I understand the legal requirements surrounding research (e.g., the Data Protection Act and the Freedom of Information Act).	4.31	.46	Very High
I can determine which statistical tool or analytical method to use for my research.	4.34	.48	Very High
I can perform common statistical tools in any statistical application, like MS Excel, SPSS, Minitab, or other apps.	4.38	.49	Very High
I can analyze and interpret the results of my statistical treatment or method analysis.	4.24	.43	Very High
I can evaluate and systematically organize the data I have gathered.	4.34	.48	Very High
Overall	**4.33**	**.47**	**Very High**
Writing and Reporting of Results			
I have excellent knowledge of language(s) appropriate for research, including technical language.	4.25	.43	Very High
I can understand, interpret, create, and communicate appropriately within an academic context.	4.34	.48	Very High
I can prepare grammatically and syntactically correct content for presentations.	4.30	.46	Very High
I can communicate research results clearly.	4.42	.49	Very High
I can construct a clear thesis statement.	4.37	.48	Very High
I can organize my thoughts and ideas clearly and prepare a research manuscript.	4.36	.48	Very High
I can construct my own conclusion based on the information gathered.	4.33	.47	Very High
I can communicate the results of my research process orally.	4.33	.47	Very High
Overall	**4.34**	**.47**	**Very High**
Grand Total	**4.34**	**.47**	**Very High**

Relationship Between Epistemic Curiosity and Perceived Critical Thinking Disposition

Table 5 shows a negligible, non-significant correlation between epistemic curiosity and perceived critical thinking disposition ($r = -.34$, $p = 0.34$), indicating that, in this sample, a higher tendency toward curiosity did not correspond to stronger critical thinking skills. This result aligned with empirical evidence from prior research. For instance, Fahruddin et al. (2022) examined how different types of epistemic curiosity relate to critical thinking in a classroom context. They cautioned that curiosity alone did not reliably predict critical thinking performance. Muis et al. (2021) found that, although curiosity was associated with critical thinking in tasks requiring the

evaluation of conflicting scientific information, the relationship depended heavily on participants' epistemic cognition and emotional responses, suggesting that curiosity's effect on critical thinking may be indirect and mediated by other cognitive or affective processes. Furthermore, Mussel (2022) showed that curiosity, over time, predicted epistemic behaviors associated with academic performance but did not necessarily translate directly into immediate gains in critical thinking.

Table 5. *Relationship Between Epistemic Curiosity and Critical Thinking Disposition*

Variables	*r-value*	Description	*p-value*	Interpretation
EC and CTD	-.34	Negligible Correlation	.34	Not Significant

EC = Epistemic Curiosity, **CTD** = Critical Thinking Disposition

Relationship Between Perceived Critical Thinking Disposition and Research Competence

Table 6 shows a very low, statistically nonsignificant correlation between perceived critical-thinking disposition and research competence (r = .17, p = 0.63). This indicated that, in this sample, higher critical thinking skills did not correspond with greater research competence. This finding is consistent with the existing literature, which portrays research competence as a multidimensional construct that cannot be explained by critical thinking disposition alone. For instance, George-Reyes et al. (2023) emphasized that research competence among university students involves various components, including complex thinking, digital literacy, methodological expertise, and collaborative skills. Their study, within an Education 4.0 framework, found that although students reported perceived improvements in research skills after exposure to digital and complex-thinking interventions, objective assessments revealed a mismatch between perceived and actual competence. This suggests that critical thinking skills, or even the perception of possessing them, are insufficient to ensure adequate research competence without additional skills and practical experience.

Table 6. *Relationship Between Critical Thinking Disposition and Research Competence*

Variables	*r-value*	Description	*p-value*	Interpretation
CTD and RC	.17	Very Low Correlation	.63	Not Significant

CTD = Critical Thinking Disposition, **RC** = Research Competence

In a related study, Indah et al. (2022) examined the relationships between research competence, critical thinking skills, and digital literacy among Indonesian EFL students. They found that research competence was significantly associated with digital literacy, whereas critical thinking skills alone were not. This finding further supports the notion that critical thinking must be complemented by other competencies, particularly digital skills, to contribute effectively to research competence. Similarly, a systematic review by Andreucci-Annunziata et al. (2023) highlighted the conceptual challenges surrounding critical thinking in higher education. They noted the absence of a universally accepted definition, with critical thinking often regarded as a composite of cognitive skills and attitudes. Moreover, the review found that the effectiveness of teaching strategies aimed at enhancing critical thinking varies widely across disciplines and contexts. This variability makes it difficult to establish a straightforward relationship between critical-thinking disposition and research competence across educational settings.

Relationship Between Epistemic Curiosity and Research Competence

Table 7 shows a negligible, non-significant correlation between epistemic curiosity and research competence (r = -.23, p = .53). This indicates that higher levels of curiosity were not associated with stronger research competence among the respondents. The negative coefficient also suggested a slight but non-significant tendency for students with higher curiosity to obtain lower competence scores. This pattern aligns with recent research that differentiates between the motivation to seek information and the ability to engage effectively in structured research tasks. For instance, Huanepi et al. (2021) reported that although epistemic curiosity prompts students to seek new knowledge, it does not ensure that they possess the methodological reasoning or strategic problem-solving abilities required for competent research performance. Their findings demonstrated that inquisitive learners often struggled to choose appropriate strategies for addressing complex academic tasks, indicating that curiosity must be paired with explicit training in research processes.

Table 7. *Relationship Between Epistemic Curiosity and Research Competence*

Variables	*r-value*	Description	*p-value*	Interpretation
EC and RC	-.23	Negligible Correlation	.53	Not Significant

EC = Epistemic Curiosity, **RC** = Research Competence

Similarly, Fadillah et al. (2024) observed that students with intense curiosity in science learning contexts did not consistently demonstrate higher academic achievement or research-oriented performance. They concluded that curiosity functions primarily as a motivational factor that requires structured instructional support before it can influence concrete learning outcomes. In the absence of such support, curiosity-driven exploration may not align with the systematic, disciplined processes that research demands. A comparable pattern was noted by Harford (2024), who discussed the relationship between curiosity and distraction. He explained that curious learners may devote substantial time to peripheral or tangential information, particularly in digital environments that encourage rapid shifts in attention. This tendency may reduce their focus on the sequential and technical steps required to complete research tasks effectively, thereby contributing to lower competence scores.

Mediation Analysis

Table 9 presents the significance of mediation analyzed using the Sobel z-test. The mediation analysis showed that epistemic curiosity did not significantly mediate the relationship between perceived critical thinking disposition and research competence. The path from perceived critical thinking disposition to epistemic curiosity was weak (a = .07), and the path from epistemic curiosity to research competence was also minimal (b = .10), indicating a limited transmission of influence across the mediation model. The Sobel test yielded a z value of .16 with a corresponding p value of .88, which exceeded the .05 level of significance. This result indicates that the indirect effect of perceived critical thinking disposition on research competence, mediated by epistemic curiosity, was not statistically significant. In practical terms, the findings suggest that epistemic curiosity did not function as a bridging mechanism between students' perceived critical thinking disposition and their research competence. Instead, the influence of critical thinking on research competence may operate through other instructional, cognitive, or metacognitive factors that were not examined in the present study.

Table 8. *Significance of Mediation*

Path (Mediation Model)	*a (IV → Mediator)*	*SEa*	*b (Mediator → DV)*	*SEb*	*Sobel z*	*p-value*	Interpretation
CTD → EC → RC	.07	.34	.10	.42	.16	.88	No mediation

Jovanović et al. (2024) found that metacognitive abilities, particularly the skills involved in monitoring and regulating one's own understanding, were stronger predictors of both academic performance and general school achievement than epistemic curiosity. Their results suggested that while curiosity may stimulate initial interest, it is metacognitive competence that ultimately drives successful learning outcomes. Similarly, Koyuncuoğlu (2023) reported that metacognition significantly enhanced academic success through the mediating role of self-efficacy, further indicating that internal regulatory processes, rather than curiosity alone, are essential in shaping student performance. These findings reinforce the interpretation that epistemic curiosity is insufficient to mediate the relationship between perceived critical thinking disposition and research competence, because meaningful competence development depends more on strategic, self-regulated learning mechanisms than on interest-driven exploration.

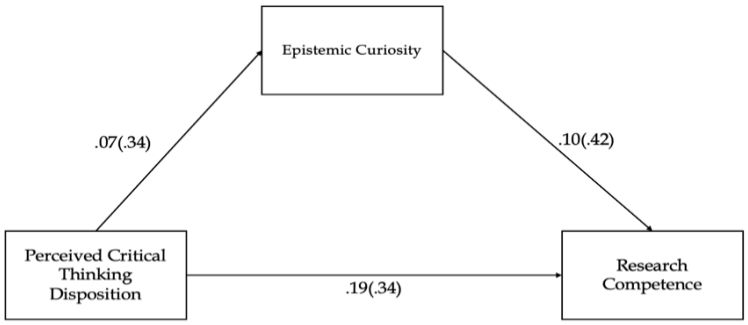

Figure 1. *Medgraph*

Figure 1 illustrates the relationships tested among perceived critical thinking disposition, epistemic curiosity, and research competence, with epistemic curiosity proposed as a mediating variable. In the model, perceived critical thinking disposition was treated as an exogenous variable, epistemic curiosity as an intervening variable, and research competence as an endogenous outcome variable. The model examined whether students' critical-

thinking disposition directly influenced research competence and whether their level of epistemic curiosity mediated this relationship. The first pathway showed a weak positive relationship between perceived critical thinking disposition and epistemic curiosity ($\beta = .07$), indicating that critical thinking disposition had only a minimal influence on students' curiosity for acquiring new knowledge. The second pathway revealed a small positive effect of epistemic curiosity on Research Competence ($\beta = .10$), suggesting that curiosity alone contributed only marginally to research-related skills.

In contrast, the direct path from perceived critical thinking disposition to research competence was stronger ($\beta = .19$), indicating that perceived critical thinking disposition directly influenced research competence independent of epistemic curiosity. These results demonstrated the absence of a mediating effect, as the indirect pathway through epistemic curiosity was weak and insufficient to explain the relationship between critical thinking disposition and research competence. Thus, research competence appeared to be driven primarily by students' disposition toward critical thinking rather than by curiosity-mediated processes.

Conclusion

The study found that senior high school students demonstrated very high levels of epistemic curiosity, perceived critical-thinking dispositions, and research competence. Despite these high levels, the results indicated that these variables did not significantly predict one another. Neither perceived critical thinking disposition nor epistemic curiosity showed a significant direct or indirect effect on research competence, and epistemic curiosity did not significantly mediate the relationship between perceived critical thinking disposition and research competence. This suggests that although students possess strong cognitive dispositions and high motivation to learn, these traits alone do not necessarily translate into measurable improvements in research competence. The lack of significant relationships implies that students' research skills may be more strongly influenced by external and instructional factors, such as structured research experiences, explicit guidance, and sustained academic support, rather than by internal dispositions alone.

In light of these findings, a program entitled *Project QUEST (Questioning and Uplifting Engaged Student Thinkers)* will be proposed to enhance research competence while maintaining high levels of curiosity and cognitive disposition among students. The program integrates curiosity-driven learning with explicit instruction in research methodology, metacognitive strategies, and self-regulated learning. Initiatives include guided inquiry projects, scaffolded research exercises, scheduled consultation periods, and accessible research hubs equipped with digital tools. Teachers will model research processes and provide structured instruction, while students engage actively in inquiry- and project-based learning. To ensure effectiveness, students' research competence and engagement may be assessed before and after interventions. Project QUEST aims for at least 80% of participants to demonstrate measurable improvements in research skills and application, bridging the gap between intrinsic curiosity and systematic research competence.

Meanwhile, efforts should focus not only on strengthening research instruction but also on maintaining the already high levels of epistemic curiosity, perceived critical thinking disposition, and research competence among students. The Department of Education may contribute by providing more straightforward curriculum guidelines, professional development for teachers in research methodology and metacognition, and resources for school-based research facilities. School administrators can support structured research environments through research coaching teams, consultation schedules, and accessible digital research tools. Students are actively encouraged to participate in research activities and reflective learning. Future researchers may explore additional mediating variables, employ broader and more diverse research designs, and investigate strategies for effectively translating curiosity into applied research competence.

Contributions of Authors

Author 1: conceptualization, methodology, data collection, formal analysis, writing – original draft, supervision, data analysis
Author 2: writing, reviewing, and editing
Author 3: writing, reviewing, and editing
Author 4: checking

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Conflict of Interests

No conflict of interest.

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