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The Mediating Effect of Autonomous Learning on the Relationship between Critical Thinking and Learning Behavior of Senior High School Students

[1]Hanie Beth C. Lebante, [2]Ester Jean U. Pelayo

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Abstract: **The study investigates the mediating effect of autonomous learning on the relationship between critical thinking and learning behavior of Senior High School Students. Utilizing a quantitative research design and mediation analysis through stratified random sampling, data were collected from 300 respondents in grades 11 and 12 of public secondary schools in the Municipality of Lupon. The research instruments for the study were carefully selected and adapted questionnaires aimed at assessing the key constructs of critical thinking, learning behavior, and autonomous learning. Statistical analyses included the Mean, Pearson-Product-Moment Correlation Coefficient, and Path Analysis. The results revealed a high level of critical thinking skills, learning behavior, and autonomous learning among senior high school students. Furthermore, a significant relationship was found between critical thinking skills, learning behavior, and autonomous learning. Autonomous learning was identified as a partial mediator in the relationship between critical thinking and learning behavior of Senior High School Students.**

The findings suggest that interventions aimed at improving autonomous learning strategies could be effective in enhancing both critical thinking and positive learning behaviors among senior high school students.

Keywords: **education, autonomous learning, critical thinking, learning behavior, quantitative research, mediation, Philippines.**

SDG Indicator: Quality Education (SDG 4)

1. INTRODUCTION

Senior high school marks a crucial stage in a student's academic journey, laying the foundation for higher education and future careers. In the contemporary educational landscape, the issue of students' learning behavior has emerged as a critical concern, influencing their success in mastering various subjects. A significant challenge arises as many students are unaware of their learning behaviors, hindering their ability to navigate the learning process seamlessly. Students often encounter difficulties expressing their ideas verbally, with some opting for silence and overactive participation in the classroom (Yulmiastri et al., 2019). This issue becomes even more pronounced in light of a growing trend of student's disengagement from the learning process, as revealed by OECD's 2019 study, where one in five 15-year-olds globally expressed disinterest in school (OECD, 2019). The implications of this learning behavior problem extend beyond the classroom, significantly impacting students' academic success and future opportunities. Urgent attention is required to address and remedy this pervasive challenge in education.

Senior high school students' learning behaviors are critical in shaping their academic trajectory and personal development. Effective behaviors like motivation, metacognition, study skills, and collaboration (Fredricks et al., 2023; Zimmerman, 2022) demonstrably enhance academic performance and self-efficacy (Richardson et al., 2019). Intrinsic motivation fuels sustained engagement and enjoyment of learning (Harter, 2020), while strong metacognition empowers students to navigate

complex challenges and regulate their learning (OECD, 2020). Collaborative learning fosters communication, diverse perspectives, and social-emotional well-being (Johnson et al., 2020; Wentzel, 2019), preparing students for future academic and professional endeavors. Investing in cultivating these positive behaviors through differentiated instruction, explicit skill development, and supportive environments empowers students to excel in senior high school and thrive throughout their lifelong learning journey.

In senior high school, learning behavior and critical thinking abilities are closely related, creating a feedback loop supporting academic achievement and personal development. The application of cognitive techniques or abilities that raise the likelihood of a desired result is known as CT. It is used to characterize deliberate, logical, and goal-directed thinking—the type of thinking that goes into problem-solving, drawing conclusions, estimating probabilities, and reaching decisions—when the thinker employs considerate and efficient techniques for the specific situation and kind of thinking task. (Halpern et. al., 2021). This active engagement fuels intrinsic motivation, a key driver of positive learning behavior (Harter, 2020), leading students to delve deeper into challenging topics and persist through difficulties.

Moreover, research suggests that senior high school students with strong critical thinking skills are well-positioned to become autonomous learners. Studies by Yüce (2023) and Demir & Cetinbas (2023) establish a positive predictor relationship between critical thinking and autonomous learning, highlighting its crucial role in empowering students to take ownership of their learning journey. This connection stems from the very essence of critical thinking. As O'Reilly et al. (2022) define, critical thinking involves providing sensible explanations for ideas and behaviors. This ability translates directly into the essential skills of autonomous learning, such as evaluating information, questioning assumptions, and forming independent judgments.

Furthermore, the landscape of senior high school learning undergoes a captivating transformation when considering the intricate connection between autonomous learning and student learning behavior. Studies by Sides, J. D., & Cuevas, J. A. (2020) reveal a synergistic relationship where autonomous learning behaviors, characterized by self-regulated learning strategies and independent goal setting, positively influence overall learning behaviors. This empowers students to become active participants in their learning journey, exhibiting more self-directed study habits, engagement in challenging tasks, and increased intrinsic motivation (Deci & Ryan, 2023). This translates into positive learning behaviors like actively seeking feedback, utilizing diverse learning resources, and persevering through challenges.

A study underscored the importance of integrating critical thinking into learning (Ahmed, 2023). This study advocated for making critical thinking a daily education activity to improve student learning experiences. Critical thinking contributes to better decision-making and enhances the overall quality of learning behavior. It encourages students to engage with course material more deeply, meaningfully, ultimately fostering more effective learning. Additionally, critical thinking skills equip students with the tools to self-regulate their learning, effectively planning, monitoring, and adjusting their study strategies based on their understanding (Zimmerman, 2022). This self-regulated behavior, in turn, fosters a positive learning environment where students are confident, autonomous learners (OECD, 2020). Ultimately, the synergy between critical thinking and positive learning behavior empowers senior high school students to excel academically and develop essential skills for lifelong learning and success.

Consequently, the literature collectively emphasized the importance of critical thinking in learning behavior and its potential impact on various aspects of education. Critical thinking not only enhances the learning experience but also plays a fundamental role in transformative learning, knowledge acquisition, and the evaluation of arguments. These findings underscored the need for educational institutions to promote and integrate critical thinking into the learning process to empower students with the cognitive tools necessary for effective, meaningful learning behavior.

Several studies provided valuable insights into factors such as motivation, self-efficacy, and self-assessment, correlating with autonomous learning behavior. A study identified a strong connection between learning motivation and autonomous learning behavior among college students (Bai, 2020). Motivation plays a pivotal role in driving learning behavior, as students with high intrinsic motivation tend to engage more actively in their studies. Autonomous learners often exhibit higher levels of intrinsic motivation, driven by their interests and passions, influencing their learning behavior. These students are more likely to persevere in their studies and remain focused on their learning goals. Moreover, several studies, including Yan-fen (2013) and Chen et.al. (2020), have found a significant correlation between self-efficacy and autonomous learning ability. Self-efficacy refers to one's belief in one's ability to achieve goals and overcome challenges. Students with higher self-efficacy tend to exhibit more autonomous learning behavior. In addition, the study noted that most students

could not learn autonomously; that is, they lacked skills in decision-making and self-management (D.Ginting, 2020). This finding highlights the development aspect of learning autonomous learning behavior. Transitioning to autonomous learning requires awareness and the acquisition of skills and habits that support self-directed learning.

In conclusion, the literature provides robust evidence of a correlation between autonomous learning and learning behavior. Motivation, self-efficacy, self-assessment, and the development of autonomous skills influence how students approach their learning experiences. Furthermore, the link between autonomous learning skills in educational settings can impact an individual's commitment to learning throughout their life.

Veettil and Binu (2021) further emphasize this connection, highlighting how critical thinking equips learners with the tools to unravel complex meaning in language and facilitate self-expression. This empowers students to navigate the learning process independently, seeking answers beyond rote memorization and actively constructing their own understanding. The research extends beyond senior high school, demonstrating the interconnectedness of these skills across various educational contexts (Faramarzi et al., 2016; Mahmoudi & Asadi, 2016; Papamitsiou & Economides, 2019). This suggests that fostering critical thinking early on sets the stage for lifelong autonomous learning, a valuable skill for navigating an information-rich world.

Additionally, studies involving EFL students have been done. Higher degrees of independent learning were associated with more sophisticated critical thinking skills in students (Daniel, 2023). The study discovered a strong favorable association between critical thinking and self-directed learning. The two construct link implies that improving EFL learners' critical thinking and autonomous skills could benefit language learners.

Ultimately, the evidence paints a clear picture of critical thinking acts as a launchpad for autonomous learning in senior high school. By cultivating this essential skill, we empower students to become independent, lifelong learners ready to tackle challenges and contribute meaningfully to society.

The focus of the current review of the literature is an interesting research project that explores the complex links between critical thinking, learning behavior, and autonomous learning among senior high school students in the Municipality of Lupon, Davao Oriental. To understand how critical thinking and learning behavior are related, this study intended to shed light on the possible mediating role of autonomous learning. Studying such complex dynamics has significant implications for our understanding of educational processes and the elements that influence successful learning outcomes.

Despite the growing body of research exploring the linkages between critical thinking, autonomous learning, and learning behavior among senior high school students, a notable research gap persists in understanding the grey dynamics of this triadic relationship. Existing literature has primarily focused on individual components such as critical thinking skills, learning behaviors, and the role of autonomous learning as a mediator. However, a dearth of comprehensive investigations delve into the complex interplay among these factors in the context of senior high school education in the post-pandemic era. Furthermore, a more comprehensive exploration is warranted to uncover potential variations in the mediating effect of autonomous learning, considering diverse student backgrounds, learning environments, and educational contexts. Consequently, this study seeks to address this research gap by providing a more comprehensive and contextually grounded understanding of how autonomous learning mediates the relationship between critical thinking and learning behavior among senior high school students.

The study examines the mediating effect of autonomous learning on the correlation between critical thinking and learning behavior among senior high school students. The investigation addresses several objectives: firstly, identifying the level of critical thinking by exploring components such as interpretation, analysis, evaluation, inference, explanation, and self-regulation (Payan-Carreira et.al., 2022); secondly, assessing the level of learning behavior in senior high school students with a focus on competence motivation and strategy/flexibility (Chao et al.,2018); thirdly, measuring the autonomous learning of senior high school students (Nguyen & Habok, 2021); and fourthly, determining the degree of relationship between autonomous learning and learning behavior, autonomous learning and critical thinking, as well as critical thinking and learning behavior. Additionally, the study aims to establish whether autonomous learning mediates the relationship between critical thinking and learning behavior.

The hypotheses formulated for this research were tested at a 0.05 significance level. These null hypotheses encompassed exploring the degree of relationship between autonomous learning and learning behavior, autonomous learning and critical thinking, and critical thinking and learning behavior. First, there is no significant relationship between critical thinking and learning behavior, between critical thinking and autonomous learning, and between autonomous learning and learning

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behavior. Furthermore, the study aimed to verify if autonomous learning indeed acts as a mediator in influencing the relationship between critical thinking and learning behavior.

The review also examined the connections among critical thinking, autonomous learning, and learning behavior. This led to a thorough discussion of the theoretical framework that suggests autonomous learning as a potential mediator in the complex connection between critical thinking and learning behavior.

The study rested on a foundation of Self-Determination Theory (SDT) as its main explanatory theory. SDT, proposed by Deci and Ryan (2023), emphasizes the importance of intrinsic motivation fueled by autonomy, competence, and relatedness in fostering positive learning experiences. This theory perfectly aligned with the premise of autonomous learning acting as a mediator. When students feel empowered and in control of their learning (autonomy), it fuels their competence and increases their sense of relatedness to the learning process. This intrinsic motivation translates into positive learning behaviors like active engagement, deeper understanding, and self-regulated studying.

While SDT provides the core framework, two additional theories offer valuable support. First, Social Cognitive Theory (SCT), developed by Bandura (1986), focuses on self-efficacy and how individuals learn through observation, modeling, and self-reflection. In this context, critical thinking skills like analyzing information and questioning assumptions can be seen as learned behaviors acquired through practice and observing models. These skills then contribute to self-efficacy, empowering students to tackle challenges and engage actively in learning, leading to positive learning behaviors. Secondly, Metacognition: Theories like Flavell's (1979) metacognitive model further explain how critical thinking skills directly support self-regulated learning behaviors. By equipping students with skills like planning, monitoring, and evaluating their learning, critical thinking acts as a cornerstone for autonomous learning and its positive outcomes.

Therefore, while SDT serves as the main explanatory theory, drawing upon SCT's insights into learning through social interaction and self-efficacy and metacognition's understanding of how critical thinking supports self-regulation creates a robust theoretical framework for comprehending the complex interplay between critical thinking, autonomous learning, and learning behavior in senior high school students.

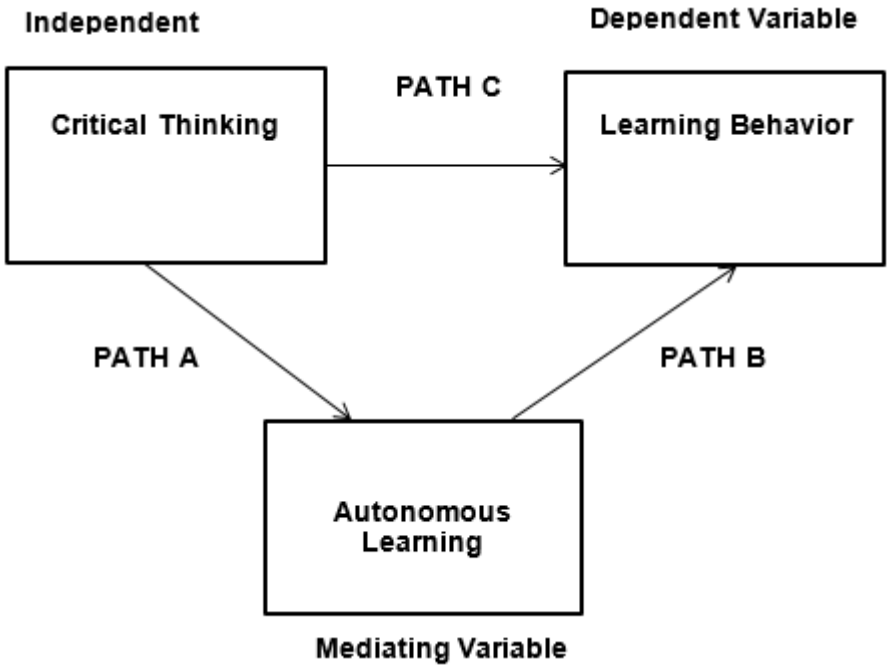

Figure 1: Conceptual Framework of the Study

Figure 1 illustrates the hypothesized model of the study, showcasing the direct relationship between Critical Thinking and the Learning Behavior of Senior High School Students, mediated by Autonomous Learning. Path A depicts the direct effect of critical thinking (independent variable) on autonomous learning (mediating variable). Path B shows the direct effect of autonomous learning on learning behavior (dependent variable). Finally, Path C represents the direct effect of critical thinking on learning behavior.

The independent variable in the model is the critical thinking. It encompasses vital sub-skills such as interpretation, analysis, evaluation, inference, explanation, and self-regulation (Payan-Carreira et al., 2022). These subskills are discussed in Facione 2020. While analysis assesses the quality of reasoning and the connections between various pieces of information, interpretation is essential for digesting and comprehending various information. Self-regulation promotes metacognitive awareness and cognitive control; evaluation evaluates the veracity of assertions; explanation clarifies the reasoning process; and inference is essential for reaching logical conclusions and considering pertinent information (Facione, 2020).

Competence, desire, and strategy/flexibility are components of the dependent variable, learning behavior (Chao et al., 2018). Flexibility is the ability to learn flexibly and respectfully, whereas competence motivation explores people's drive and excellence in successful situations.

Finally, the mediating variable, autonomous learning—the learner's ability to independently acquire important knowledge or abilities through their chosen methods—acts as a mediating factor (Chene,1983). According to the measure's implicit operational definition, self-directed learners take responsibility for their education, show that they are motivated to learn, enjoy learning, are open-minded, have good time management skills, make good plans, meet deadlines, persevere in the face of difficulties, and procrastinate less.

Thus, it is imperative to comprehend that the interaction that exists between autonomous learning, critical thinking and learning behavior in senior high school students holds significant implications across multiple levels. Globally, fostering autonomous learning contributes to sustainable development Goal 4 (Quality Education). SGD 4 aims to ensure inclusive and equitable education and promote lifelong learning opportunities for all. Promoting autonomous learning empowers students to participate actively in their education. The ability to think critically and regulate one's learning is directly linked to developing self-directed learners, enhancing their capacity to succeed in an ever-changing world and contribute to a sustainable future.

Societally, it promotes responsible citizenship through enhanced critical thinking and effective learning behaviors. Understanding this mediation Within the school environment allows for developing targeted pedagogical approaches that nurture independent learning skills. For teachers, this research informs instructional strategies that empower students to participate actively in education. Students benefit directly from improved learning outcomes and enhanced self-efficacy. Finally, future researchers can build upon these findings to explore the nuances of autonomous learning and its impact on various educational contexts and student populations, leading to more effective interventions and policies.

2. METHOD

This chapter depicts the various methods of the study, including research respondents, materials and instruments, and design and procedure used in the study.

Research Respondents

The respondents in this study were 1, 647 students in grades 11 and 12 from four secondary schools in the Municipality of Lupon, Davao Oriental, School A had 51 students in grade 11 and 51 in grade 12. School B had 260 grade 11 and 273 grade 12 students, School C had 507 grade 11 and 419 grade 12 students. School D had 41 grade 11 and 45 grade 12 students. The participants were selected based on specific criteria, including their ability to provide informed consent and assent, possession of basic reading and writing skills, and capability for active participation in the survey.

The sampling technique employed in this study includes the distribution of respondents through stratified random sampling. It is a good technique for selecting a sample, and there is a chance for each member of the population to pick a sample (Eliyahu & Etikan, 2021). This method involves dividing the population into subgroups or strata, such as grade levels or specific schools, and selecting a random sample from each stratum. This technique was used to ensure a representative and diverse sample that includes students from various relevant categories.

The sample size of 300 respondents was determined using the Raosoft Calculator, an online tool designed to calculate sample sizes. This calculation aimed to achieve a 4.32% margin of error with a 95% confidence level, striking a balance between statistical reliability and practical feasibility for the researchers. This approach aligns with recommendations from prominent researchers like Memon, M. A., et al. (2020b) in the article, the Sample Size for Survey Research: Review and Recommendations—Journal of Applied Structural Equation Modeling.

In terms of participant management, the study implemented clear inclusion and exclusion criteria. Inclusion criteria emphasize the ability to provide informed consent and assent, basic reading and writing skills, and the capability for active survey participation. Inclusion criteria highlighted the participants' male and female senior high school age range of 16-20 years old, both male and female students for Grade 11 and 17-20 years old, both male and female students for Grade 12. Exclusion criteria excluded non-Grade 11-12 students and those not enrolled in the school year 2023-2024.

The study also made withdrawal provisions, acknowledging participant involvement's dynamic nature. Participants had the option to withdraw from the study at any point, and their decision to do so would not incur any negative consequences. These measures aimed to ensure ethical considerations and protect the well-being of the participants throughout the research process.

Materials and Instrument

The research instruments for the study were carefully selected and adapted questionnaires aimed at assessing the key constructs of critical thinking, learning behavior, and autonomous learning. These instruments are as follows:

Critical Thinking Self-Assessment Scale adapted from Payan-Carreira et al. (2022) is designed to measure the various facets of critical thinking. The scale is based on a six-factor empirical model, which includes Interpretation, Analysis, Evaluation, Inference, Explanation, and Self-regulation. The adaptation of this scale was validated through confirmatory factor analysis, ensuring its reliability and validity. The use of a Likert scale with five levels of responses ranging from Strongly Agree (5) to Strongly Disagree (1) allows students to self-assess their critical thinking skills across these six dimensions. The high Cronbach alphas for the overall instrument and individual scales confirmed its reliability, making it suitable for assessing critical thinking skills. As a result, the reliability for this scale demonstrated a Cronbach's alpha of .890, a Cronbach's alpha based on standardized items of .947, and an N of items of 60 wh, which is interpreted as a good internal consistency description.

Learning Behavior Questionnaire adapted from Chao et al. (2018) assessed the two vital aspects of learning behavior: Competence Motivation and Strategy/Flexibility. It underwent exploratory and confirmatory analyses to validate its two-factor structure. The scale's reliability was demonstrated through high Cronbach alpha coefficients for both Competence Motivation and Strategy/Flexibility. Students were provided with items designed to gauge their motivation to excel academically and their adaptability in learning strategies, ensuring that these critical aspects of learning behavior are comprehensively assessed. As a result, the reliability of this scale demonstrated a Cronbach's alpha of. 771, a Cronbach's alpha based on standardized items of .790, and a N of items of 24 of, which is interpreted as acceptable internal consistency.

Autonomous Learning is Measured using the Learner Autonomy Scale adapted from Macaskill and Taylor (2010). This scale assessed students' ability to take responsibility for their own learning, an essential component of autonomous learning. The questionnaire's Cronbach alpha of .81 indicated its reliability. The expert validation process further ensured that the instrument is well-suited to measure autonomous learning in the context of senior high school students. As a result, the reliability for this scale demonstrated a Cronbach's alpha of. 779, a Cronbach's alpha based on standardized items of .794, and a N of items of 12 of which is interpreted as acceptable internal consistency.

To enhance the validity and comprehensiveness of the instruments, they underwent expert validation; five experts evaluated each instrument, yielding mean scores of 4.71, 3.71, 4.28, 4.57, and 4.57. The overall mean scores across all validators were 4.368, indicating that the instruments are valid for data collection. Using a five-point Likert scale for measuring the research variables offered a practical and effective means of obtaining responses from the study's participants. The scale is adaptable for parametric analysis, enabling researchers to employ various statistical techniques for data analysis, such as calculating the mean and conducting more in-depth statistical assessments. Overall, the selection and adaptation of these instruments were aligned with the study's objectives and supported by robust validation and reliability measures.

This study assessed the levels of critical thinking, learning behavior, and autonomous learning among senior high school students, revealing a wide range of proficiency across three key areas. Those with exceptionally very high levels (mean scores 4.20- 5.00) demonstrated skills of the highest caliber. Students exhibiting high levels (3.40-4.19) showed considerably advanced abilities, while those with moderate levels (2.60-3.39) displayed intermediate skills. A lower moderate group (1.80-2.59) showed less proficiency, and students with very low levels (1.00-1.79) exhibited significant deficiencies in all three areas.

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Design and Procedure

The research design employed in the study was aligned with a cross-sectional mediation analysis approach. This quantitative research design is well-suited for examining the relationships and potential mediation effects among the variables of interest at a single point in time.

Mediation analysis is a non-experimental design, meaning the researcher does not manipulate any of the variables involved. Instead, the study relied on collecting data from a sample of senior high school students to test the hypothesized relationships between these variables. Specifically, the design allowed for the examination of whether autonomous learning (M) acts as a mediator in the relationship between critical thinking (X) and learning behavior (Y).

The data collection process began with obtaining permission from relevant authorities, including the Dean and Division Schools Superintendent, followed by general orientation and seeking informed consent from participants. Questionnaires were administered in classrooms during the fourth quarter of the school year 2023-2024, with the researcher present to explain the study's purpose and assist respondents. The study ensured ethical standards were upheld, emphasizing that participation was voluntary, responses were anonymous, and confidentiality was maintained throughout the research process.

For a comprehensive analysis of the study data, several statistical tools were employed: Mean was calculated to assess the average levels of critical thinking skills, learning behavior, and autonomous learning, providing insights into the central tendencies of these variables. The Pearson Product-Moment Correlation Coefficient was used to evaluate the significant relationships between these variables at the 0.05 alpha level, revealing the strength and direction of associations. Additionally, Path Analysis was conducted to assess the direct and indirect effects of the independent variable (IV) and the mediator variable (MV) on the dependent variable (DV), clarifying the interactions between the variables.

The research strictly adhered to ethical protocols established by the University of Mindanao Ethics Committee, obtaining necessary approvals from school administrators and ensuring participants were suitable and adequately informed about risks and data handling. The study was conducted under protocol number UMERC-2024-169, with an accompanying UMERC approval certificate, ensuring that participant's rights and confidentiality were upheld throughout the research process.

3. RESULTS AND DISCUSSION

This section presents the results, interpretation, and analysis of findings. Results are presented in the following order of study objectives.

Critical Thinking of Senior High School Students

The data presents the level of critical thinking among senior high school students across six indicators: Interpretation, Analysis, Evaluation, Inference, Explanation, and Self-Regulation. Each indicator has an associated standard deviation (SD), mean, and descriptive level, all of which are rated as "High."

Table 1: Level of Critical Thinking of Senior High School Students

Indicator	SD	Mean	Descriptive Level
Interpretation	0.49	4.02	High
Analysis	0.53	4.00	High
Evaluation	0.59	3.98	High
Inference	0.52	4.05	High
Explanation	0.55	3.95	High
Self-Regulation	0.57	4.14	High
Overall	**0.46**	**4.02**	**High**

The overall mean of 4.02 indicates that, on average, senior high school students exhibit a high level of critical thinking. Each specific indicator with an overall SD of 0.46 also falls within the high descriptive level category, showcasing consistently strong performance across different aspects of critical thinking.

The high mean scores across all indicators suggest that the educational programs in place are effectively fostering critical thinking skills among students. The highest mean score in Self-Regulation highlights those students are particularly proficient at reflecting on and regulating their own thinking processes. This is crucial for independent learning and problem-solving.

There is a wealth of research in the literature about the value of critical thinking abilities, which also supports the findings of this investigation. Raj.T. et al. (2022) state that critical thinking fosters a variety of abilities, including communication, planning, organization, and open-mindedness. One life skill that helps you overcome obstacles in both your personal and professional life is critical thinking. It fosters independence and self-assurance, both necessary for successful lives. The author said critical thinking is the ability to reason logically and clearly about what to do or believe. It also calls for the ability to think critically and independently. When students research, evaluate, interpret, or synthesize material and apply original thought to formulate an argument and solve problems.

Furthermore, according to Shutaleva, A. (2023), critical thinking is the capacity to independently and impartially assess and analyze data. Therefore, thinking critically is essential for negotiating the complexity of environmental issues. Making well-informed decisions entails challenging presumptions, analyzing the available data, considering many viewpoints, and using logical reasoning. The development of ecological literacy—the ability to comprehend the relationships between people and the environment and critically assess environmental issues—is facilitated by critical thinking in the setting of environmental education.

However, challenges remain. The difficulties students face with interpretation—a subskill crucial to information processing and comprehension—are highlighted by Febri et al. (2019) and Glušac et al. (2020). This highlights the need for targeted educational interventions to increase interpretation skills, as Fajari et al. (2020) demonstrated that particular training strategies could improve interpretation competency.

Learning Behavior of Senior High School Students

Presented in Table 2 is the level of learning behavior among senior high school students across two indicators: competence motivation and strategy/flexibility. Each indicator has an associated standard deviation (SD), mean, and descriptive level, all rated as High.

Table 2: Level of Learning Behavior of Senior High School Students

Indicator	SD	Mean	Descriptive Level
Competence Motivation	0.56	4.09	High
Strategy/Flexibility	0.54	3.97	High
Overall	**0.52**	**4.03**	**High**

The overall mean of 4.03 is that, on average, senior high school students exhibit a high level of learning behavior. The overall SD of 0.52 of the specific indicators of learning behavior, competence motivation, and strategy/flexibility also fall within the high descriptive level category, showcasing consistently strong learning behavior among the students.

The high level of strategy/flexibility observed in the students suggests they are well-equipped to handle the demands of their academic work, adapting their approaches as necessary to achieve successful outcomes. This is supported by Almoslamani (2022), who found that effective use of learning strategies significantly predicts academic achievement.

The student's capacity to effectively apply various tactics and adjust to different learning settings is demonstrated by their mean score on the Strategy/Flexibility scale. According to Mazza, V. & Šlipogor V. (2024), behavioral flexibility is necessary for effective colonization and integration, allowing individuals to adjust to novel environments (Izquierdo et al., 2017). This adaptation enables individuals to handle difficulties affecting their survival and reproduction (Sol, 2009). To overcome novelty obstacles, behavioral flexibility is essential, as no single cognitive aptitude or phenotype is ideal for all contexts (Mazza & Šlipogor, 2024). It enables people to break away from old habits, digest new information, and generate more suitable reactions. Furthermore, Biwer et al. (2023) observed that students instructed in effective learning techniques showed significant improvements in their academic performance, emphasizing the importance of flexibility and strategy in learning.

Autonomous Learning of Senior High School Students

Presented in Table 3 is the levels of autonomous learning among senior high school students, measured through various items. The items have corresponding standard deviations, means, and descriptive levels.

The overall result indicates that these senior high school students are generally autonomous in their learning behavior. The relatively high standard deviation (0.54) suggests a notable degree of variability in autonomous learning levels among the students, indicating that while the average high, individual student performance varies considerably.

The significant difference between the highest-scoring item ("Enjoying new learning experiences," M=4.63) and the lowest-scoring item ("Being good at meeting deadlines," M=3.87) highlights a potential area of focus of pedagogical interventions. Specifically, while students demonstrate a strong intrinsic motivation for learning and engagement with the new material, developing time management and organizational skills is a crucial area for improvement to maximize their learning potential.

This suggests that educators should explicitly consider strategies to integrate these skills into the curriculum and provide individualized support where needed. The data indicates a strong foundation for self-directed learning but also points to the need for a precise approach to instruction that caters to the student population.

Table 3: Level of Autonomous Learning of Senior High School Students

Items	SD	Mean	Descriptive Level
Enjoying new learning experiences.	0.66	4.63	Very High
Trying to stick in doing complex or difficult task	0.73	3.98	High
Enjoying finding information about new topics on my own	0.89	4.16	High
Being open to new ways of doing familiar things	0.77	4.33	Very High
Taking responsibility for my learning experiences.	0.83	4.37	Very High
Enjoying being challenged	0.87	4.26	Very High
Tending to be motivated to work by having assessment deadlines.	0.88	4.11	High
Do not find excuses for not getting work done	0.94	3.93	High
Planning my time to study effectively	0.94	4.01	High
Being good at meeting deadlines	0.96	3.87	High
Seeing to it that my time management is good.	0.94	3.97	High
Being happy working on my own.	0.82	4.47	Very High
Overall	**0.54**	**4.17**	**High**

Accepting responsibility for one's education and finding satisfaction in working independently are two essential components of self-directed learning. Chatzisarantis et al. (2019) emphasized the relevance of equitable autonomy support in promoting autonomous motivation and satisfaction in academic contexts. Furthermore, intrinsic motivation and autonomous learning work hand in hand, as highly engaged and academically superior students are more likely to exhibit intrinsic motivation (Kiều My Ân, 2020).

Students' slightly lower scores in areas such as meeting deadlines and not making excuses suggest that, while they are generally self-sufficient, there are some areas where they may improve. Academic success necessitates managing one's time effectively and persevering through difficult tasks (Biwer et al., 2023). Giving students the opportunity and encouragement to practice these skills can boost their capacity for independent learning.

Torbergsen, H., Utvær, B. K., & Haugan, G. (2023) found that teachers who encourage student autonomy can positively impact intrinsic motivation, study effort, and perceived learning outcomes in first-year-year nursing students. This autonomy support strengthens the teacher-student relationship, directly influencing intrinsic motivation and perceived learning outcome and indirectly influencing study effort. The researcher suggests that a flipped classroom approach and opportunities for student collaboration may further enhance these positive outcomes. Furthermore, according to Tomasouw and Marantika (2020), learning autonomy is linked to higher-quality learning components such as motivation, active engagement, decision-making, and reflection. For this reason, developing autonomy is essential to developing productive and interesting learning settings.

Relationship between Critical Thinking and Learning Behavior of Senior High School Students

Displayed in Table 4.1 is the result of the relationship between critical thinking and learning behavior among senior high school students. The highest overall correlation coefficient is 0.779 between Critical Thinking (Overall) and Learning Behavior (Overall), suggesting a robust and statistically significant association. This indicates that as critical thinking skills increase, learning behaviors related to competence motivation, strategy/flexibility, and overall learning effectiveness also tend to improve significantly among senior high school students. Therefore, the decision of the hypothesis is rejected.

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Table 4.1: Significance of the Relationship between Critical Thinking and Learning Behavior of Senior High School Students

Critical Thinking	Learning Behavior		
	Competence Motivation	Strategy/Flexibility	**Overall**
Interpretation	.559**	.560**	**.594****
	.000	.000	**.000**
Analysis	.667**	.613**	**.679****
	.000	.000	**.000**
Evaluation	.605**	.595**	**.637****
	.000	.000	**.000**
Inference	.678**	.655**	**.708****
	.000	.000	**.000**
Explanation	.631**	.616**	**.662****
	.000	.000	**.000**
Self-Regulation	.666**	.617**	**.681****
	.000	.000	**.000**
Overall	**.748****	**.718****	**.779****
	.000	**.000**	**.000**

The correlation coefficients in Table 4.1 indicate strong positive relationships between critical thinking and learning behavior dimensions across all categories. The correlation values of .779 reveal that critical thinking abilities such as making logical inferences 0.708, providing coherent explanations 0.662, and conducting thorough evaluations 0.637 significantly contribute to students' overall learning behaviors. Moreover, the correlation with competence motivation 0.594 highlights how intrinsic motivation to excel in learning tasks is closely intertwined with critical thinking proficiency.

These findings underscore the importance of fostering critical thinking across educational contexts to cultivate well-rounded learners capable of independent and analytical thought, ultimately enhancing their overall learning outcomes and academic success. This implies a need for pedagogical shifts prioritizing active learning strategies, incorporating diverse assessment methods that evaluate critical thinking skills, and cultivating intrinsic motivation through challenging yet supportive learning environments. Further research should explore causal relationships between these factors to inform more effective educational interventions.

According to the findings, critical thinking and competence motivation are strongly positively correlated. This shows that highly competent and driven students also typically have great critical thinking abilities. This assertion is supported by the research of Satka, F., & Garneva, E (2024). The authors' project is a model of motivational competency. By using instructional and communicative methods for motivation based on values and virtues, the structured model of motivational competency can assist students in returning to their uniqueness. They promote critical thinking as well as organic and innate emotional input.

The results also show a substantial positive correlation between strategy/flexibility in learning behavior and critical thinking. This implies that kids with strong critical thinking skills tend to have adaptable learning styles. Gökçe, S. and Güner, P. (2024) assert that for the curriculum to achieve its objective, students must cultivate a tendency for critical thinking to gain cognitive flexibility.

Overall, there is a very strong association between critical thinking and learning behavior. This thorough assessment indicates a substantial correlation between improved critical thinking skills and strong learning behaviors, including competence motivation, strategy/flexibility, and other elements. This association is supported by Bellaera's (2022) research on the influence of epistemic beliefs on critical thinking. Pupils with strong epistemic convictions are more likely to interact critically with course contents, improving their general learning behaviors, such as making wise decisions and conducting thoughtful analyses.

Relationship between Critical Thinking and Autonomous Learning of Senior High School Students

Illustrated in Table 4.2. Senior high school students' critical thinking and autonomous learning demonstrate statistical significance ($p < .005$). Students who exhibit higher levels of critical thinking also tend to exhibit greater autonomy in their

learning practices, according to the overall correlation value of 0.610**, which shows a strong positive association between these two variables.

The results thus show that the null hypothesis is rejected because there is no significant association between the two variables. This significant finding has broad implications beyond the immediate educational context. Thinking critically and learning autonomously are crucial skills for navigating an increasingly complex and rapidly changing world.

Therefore, fostering these skills in students is essential for academic success and personal and professional development, contributing to a more informed and engaged citizenry.

Table 4.2: Significance of the Relationship between Critical Thinking and Autonomous Learning of Senior High School Students

Critical Thinking	Autonomous Learning
Interpretation	.460**
	.000
Analysis	.536**
	.000
Evaluation	.500**
	.000
Inference	.564**
	.000
Explanation	.505**
	.000
Self-Regulation	.540**
	.000
Overall	**.610****
	.000

The highest correlation observed is between Inference critical thinking and Autonomous Learning, with a correlation coefficient of 0.564**. This indicates that the ability to draw logical conclusions and make reasoned judgments and inferences is closely linked to students' capacity for autonomous learning. Critical thinking skills enable students to process information critically and independently, enhancing their ability to engage autonomously in learning tasks.

The correlation between critical thinking indicators, analysis, and autonomous learning is closely followed, with a coefficient of 0.536**. This highlights that student's adept at critically analyzing information are more likely to engage in autonomous learning behaviors. Critical analysis involves breaking down complex information, identifying key components, and discerning relationships, all essential for autonomous learning, where students take initiative and responsibility for their learning processes.

Evaluation as an indicator of critical thinking shows a correlation coefficient of 0.500**, emphasizing the importance of students' ability to assess and appraise information in relation to their autonomous learning behaviors. Effective evaluation skills enable students to judge the quality and relevance of information independently, contributing to their autonomy in seeking out and utilizing resources for learning.

Similarly, Explanation (Critical Thinking) and Self-Regulation (Critical Thinking) correlate with Autonomous Learning at coefficients of 0.505** and 0.540**, respectively. These correlations underscore how students' capabilities to provide coherent explanations and to monitor, control, and direct their learning processes enhance their autonomy in learning. Clear explanations facilitate understanding and effective communication of ideas, while self-regulation fosters independence and self-directedness in learning endeavors.

This comprehensive relationship between critical thinking and autonomous learning is supported by existing literature. According to Yüce (2023), autonomous learning is favorably predicted by critical thinking behaviors. This is consistent with recent research, highlighting the value of encouraging critical and independent thinking in classrooms to equip students with the cognitive abilities needed for self-directed and life-changing learning experiences. This conclusion is supported by Varías (2022), who observed that pupils with higher degrees of autonomous learning also tended to have more sophisticated critical thinking skills. This research implies that critical thinking abilities are fostered by autonomous learning, which in

turn improves students' capacity for independent and self-directed learning. Similarly, Iqbal (2021) found that an autonomous learner approach positively impacted the critical thinking skills of students and teachers, indicating that students who engage in thoughtful analysis and problem-solving are better equipped for autonomous learning.

Table 4.3: Significance of the Relationship between Autonomous Learning and Learning Behavior of Senior High School Students

	Learning Behavior		
	Competence Motivation	Strategy/Flexibility	**Overall**
Autonomous Learning	.761**	.685**	**.769****
	.000	.000	**.000**

The data in Table 4.3 reveals significant correlations between Autonomous Learning and various aspects of Learning Behavior among Senior High School Students. The overall correlation value of 0.769** underscores a strong positive relationship, indicating that students who exhibit higher levels of autonomous learning are likely to demonstrate more effective learning behaviors. This finding is supported by Bai (2020), who identified a strong connection between learning motivation and autonomous learning behavior among higher education students. Autonomous learners, driven by intrinsic motivation, tend to engage more actively and effectively in their studies, influencing their overall learning behavior.

Following this, the correlation between Autonomous Learning and Competence Motivation stands at 0.761**. This aligns with Yan-fen (2013) and Chen et al. (2020), who found a significant correlation between self-efficacy and autonomous learning ability. Students with high self-efficacy exhibit more autonomous learning behavior, as they believe in their ability to achieve goals and overcome challenges. This confidence drives their motivation to excel and influences their competence in learning tasks.

The association between strategy/flexibility and autonomous learning is 0.685**, emphasizing the flexibility and strategic nature of autonomous learning. This is consistent with the Liu et al. (2023) experiment results. It implies that the ability to use strategy with flexibility is influenced in a complicated and changing way by the direction and intensity of emotional motivation. It makes clear that when task workload is high, the level of emotional motivation significantly affects the flexibility of technique utilization. However, emotional motivation tends to be more avoidance-motivated, which is advantageous when little work is involved.

Jose (2020) found a large positive link between lifelong learning and autonomous learning, emphasizing the wider significance of autonomous learning. Autonomous learners develop skills such as planning, prioritizing, and self-motivation, which foster a disposition toward continuous personal and professional development. This commitment to lifelong learning further underscores the importance of autonomous learning in shaping effective learning behaviors.

Mediation Analysis of the Variables

This study investigates the mediating role of autonomous learning in the relationship between critical thinking and learning behavior. The mediation analysis of the variable provides a more nuanced understanding of mechanisms underlying the observed relationship between critical thinking and learning behavior, clarifying the extent to which the effect of critical thinking is mediated by autonomous learning.

Table 5: Regression analysis showing the influence of critical thinking on learning behavior as mediated by autonomous learning

Step	Path	B	S.E.	β
1	c	.869	.041	.779***
2	a	.721	.054	.610***
3	b	.442	.035	.468***
4	c’	.550	.041	.493***

* $p<0.05$

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Table 6: Results of statistical analysis on presence (or absence) of mediating effect

Combination of Variables	Sobel z	p-value	Mediation
critical thinking → autonomous learning→ learning behavior	9.151559	<0.05	Partial mediation

* $p<0.05$

This data analysis aims to ascertain if autonomous learning mediates the relationship between critical thinking skills and learning behavior among senior high school students. Table 5 presents a regression analysis showing the influence of critical thinking on learning behavior, with autonomous learning as a mediator. The path coefficients B, S.E., and β are provided for each step of the mediation analysis. Table 6 summarizes the statistical analysis results, including the Sobel test for mediation effect and effect size measures. The regression and mediation analyses (Tables 6 and 6) findings will inform the understanding of how critical thinking impacts learning behavior. Identifying a significant mediating role for autonomous learning has implications for designing educational interventions.

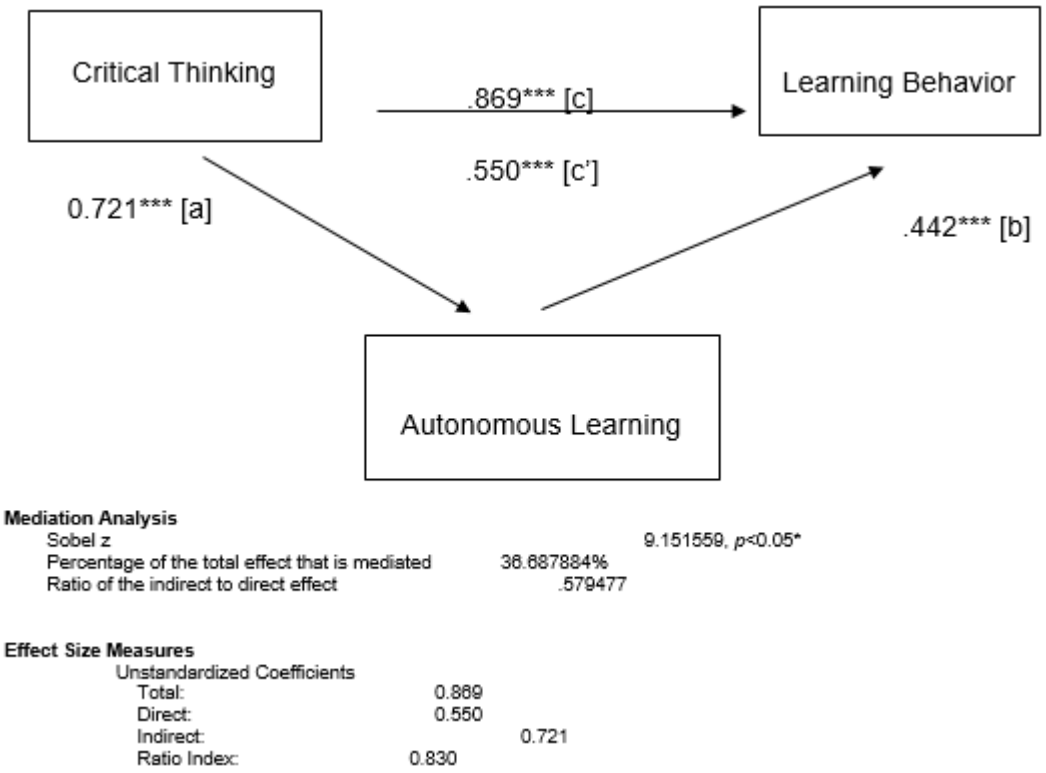

Figure 2. Medgraph showing the variables of the study

As shown in Figure 2, in Step 1, the direct effect (path c) of critical thinking on learning behavior is significant (B = 0.869, β = 0.779, p < 0.05). In Step 2, critical thinking significantly predicts autonomous learning (path a), with B = 0.721 and β = 0.610 (p < 0.05). In Step 3, autonomous learning significantly predicts learning behavior (path b), with B = 0.442 and β = 0.468 (p < 0.05). When autonomous learning is included as a mediator in the model, the direct effect of critical thinking on learning behavior (path c') decreases but remains significant (B = 0.550, β = 0.493, p < 0.05). The Sobel test result (z = 9.151559, p < 0.05) indicates a significant partial mediation effect. The mediation analysis shows that 36.69% of the total effect of critical thinking on learning behavior is mediated by autonomous learning, with an indirect effect ratio of 0.579.

The analysis demonstrates that autonomous learning partially mediates the relationship between critical thinking and learning behavior. The significant direct effect in Step 1 confirms that critical thinking independently influences learning behavior. The significant path in Step 2 indicates that critical thinking enhances autonomous learning, which, in turn, as shown in Step 3, positively affects learning behavior. The reduction in the direct effect (c') when the mediator is included confirms partial mediation. The Sobel test supports this finding, highlighting the importance of autonomous learning in this relationship. The mediation analysis suggests that autonomous learning accounts for a substantial portion (36.69%) of the effect of critical thinking on learning behavior, emphasizing its role in translating critical thinking into effective learning behaviors.

The findings are consistent with existing literature, emphasizing the interconnection between critical thinking and autonomous learning. Phan (2010) asserts that critical thinking is essential for autonomous learning, equipping learners with skills to analyze information and make informed decisions. Varías (2022) found that higher levels of autonomous learning correlate with advanced critical thinking abilities, reinforcing the idea that autonomous learning mediates the impact of critical thinking on learning outcomes. Iqbal (2021) also demonstrated that autonomous learning enhances critical thinking skills, improving learning behaviors such as problem-solving and evaluation. Mezirow (1997) highlighted the interplay between critical and autonomous thinking in transformative learning, further supporting the mediation role. These studies underscore the necessity of fostering critical and autonomous thinking in educational settings to promote effective learning behaviors.

The study's results strongly support the Self-Determination Theory (SDT) (Deci & Ryan, 2023). The significant mediation effect of autonomous learning in the relationship between critical thinking and learning behavior aligns with SDT's emphasis on the importance of autonomy, competence, and relatedness in fostering intrinsic motivation and positive learning outcomes. By demonstrating that autonomous learning partially mediates this relationship, the study confirms that autonomy is a critical component in translating critical thinking skills into effective learning behaviors, thus supporting the theoretical assumptions of SDT.

Drawing upon SCT's insights (Bandura, 1986) into learning through social interaction and self-efficacy and metacognition's (Flavell's, 1979) understanding of how critical thinking supports self-regulation creates a robust theoretical framework for comprehending the complex interplay between critical thinking, autonomous learning, and learning behavior in senior high school students. This theoretical framework supports the findings of the mediation analysis, demonstrating the significant role of autonomous learning in enhancing the effects of critical thinking on learning behavior.

4. CONCLUSION AND RECOMMENDATION

This section presents the conclusions that were reached after taking the study's findings into account. There is a high level of critical thinking skills, learning behavior, and autonomous learning. A significant relationship exists between critical thinking skills, learning behavior, and autonomous learning. Also, autonomous learning partially mediates the relationship between critical thinking and the learning behavior of senior high school students.

The study's findings conform to the notion about the mediating effect of autonomous learning on the relationship between critical thinking and the learning behavior of senior high school students. The anchor theory supports the Self-Determination Theory by Deci and Ryan (2023); the mediation effect of autonomous learning supports SDT by showing that when students have the autonomy to control their learning, their critical thinking skills are more effectively translated into positive learning behaviors. This aligns with the SDT assertion that autonomy enhances motivation and learning outcomes. Moreover, the findings of the study were substantiated by the SCT's insights (Bandura, 1986) into learning through social interaction and self-efficacy and metacognition (Flavell's, 1979), understanding of how critical thinking supports self-regulation creates a strong theoretical framework for the complex interplay between critical thinking, autonomous learning, and learning behavior in senior high school students.

Given the high level of critical thinking skills identified in senior high school students, it is recommended to further cultivate and enhance these skills through targeted educational strategies. Schools should incorporate structured critical thinking activities across the curriculum, such as debates, case studies, and problem-solving tasks. Teachers can integrate techniques that encourage students to analyze information critically, evaluate arguments, and draw reasoned conclusions through developed reading enhancement programs. Professional development programs for teachers like Monthly School and District Learning Action Cell Sessions and teachers' focus group discussions have to be strengthened, which will focus on methodologies to foster critical thinking, and monitoring the developed methodologies should also be encouraged to ensure consistent implementation in classrooms. These developed sessions will equip teachers with practical strategies and techniques for fostering critical thinking in the classroom.

Acknowledging the significant relationship between critical thinking skills and learning behavior, schools should continue to promote positive learning behaviors among students by strengthening and Implementing schools' best practices. This includes fostering a learning environment that values active engagement, independent inquiry, and self-regulated learning at school. Implementing student-centered approaches and collaborative learning activities during the teaching and learning process can enhance motivation and participation. Regular feedback mechanisms and assessments aligned with learning

objectives can also guide students toward effective learning behaviors. Teachers should be supported in adopting innovative teaching practices encouraging students to apply critical thinking skills in their learning activities.

With a high level of autonomous learning observed among senior high school students, efforts should focus on further developing these skills to empower students in their educational journey. Schools can introduce programs that promote self-directed learning, such as project-based learning, research initiatives, and personalized learning plans. Providing opportunities for students to set learning goals, manage their time effectively, and reflect on their progress can nurture autonomous learning behaviors. Encouraging digital tools and resources that support independent learning can also be beneficial.

Considering autonomous learning partially mediates the relationship between critical thinking and learning behavior, enhancing support structures that bolster autonomous learning environments is recommended. Schools should provide resources, mentorship programs, and guidance counseling that encourage students to take ownership of their learning processes. Integrating peer learning communities and collaborative projects can further enhance autonomous learning experiences. Continuous evaluation and adjustment of educational practices to align with the mediating role of autonomous learning will facilitate a more robust educational framework.

Future research endeavors should focus on expanding the scope of this study to include a larger and more diverse population of students. Qualitative research methods can provide deeper insights into the factors influencing critical thinking, learning behavior, and autonomous learning in educational settings. Additionally, exploring longitudinal studies to track the development of these skills over time and their impact on academic achievement would contribute valuable knowledge. Furthermore, investigating the role of socioeconomic factors and cultural contexts in shaping these educational outcomes can offer a more comprehensive understanding for educational practitioners and policymakers.

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