Effects of Utilization of Generative Artificial Intelligence Tools on Critical Thinking Skills of High School Students

Aivan F. Dadios[1], Megan Amber Q. Co[2], Phoebe Danica D. Pablo[3], Angella Joey P. Limbaco[4], Elmore Melashenkho Nadeak[5], Mercedes M. Ibanez[6], Rowena Imelda A. Ramos[7], Arbert A. Dagangon,[8] Maryann C. Taroquin[9], *Jared M. Ibanez[10]

Adventist University of the Philippines (Academy)
jmibanez@aup.edu.ph

ABSTRACT

The rapid development of artificial intelligence (AI) these past few years have caught the attention of many researchers. Generative Artificial Intelligence (GAI) is a type of AI that refers to a subset of artificial intelligence techniques and models that are designed to generate new data or content. Numerous tasks, such as creating images, texts, music, and more, can be performed with these models. However, critical thinking is the ability to analyze, evaluate, and interpret information and arguments in a logical and systematic manner. Critical thinking prepares students for future endeavors, and more. Thus, this study aimed to determine if the use of GAI tools has an effect on the critical thinking skills of high school students. The respondents were students from Adventist University of the Philippines during school year 2023-2024 who were chosen randomly per section to achieve the desired number of samples. The findings of this study shows that students moderately use GAI and they have high levels of critical thinking skills. Furthermore, the results show that usage of GAI tools enhance the students' critical thinking skills. This study concluded that the use of GAI should not be discouraged but, incorporate learning methods that may help the critical thinking skills enhancement of the students. Lastly, this study recommends to explore the different effects on the dimensions of critical thinking skills of students using GAI when their sex, ages and type of GAI tools they use are considered.

Keywords: *generative artificial intelligence, critical thinking skills, AI tools utilization*

INTRODUCTION

As the progression of Artificial Intelligence (AI) went more, the first Generative Artificial Intelligence (GAI) tool was created in late 2022 called ChatGPT. It has sparked a global race among technology companies to develop GAI models. GAI describes systems and algorithms that leverage deep learning to produce creative output, such as music and art, at the user's request. Depending on the precise user input, each GAI can generate distinct sets of creative works by exploiting the enormous quantity of data that has already been fed in (Thormundsson, 2024). A recent overview of trends in education, AI has been used in intelligent tutoring systems for students to use such as ActiveMath, The Auto Tutor, and many more (Chassignol et al., 2018).

Since the presence of GAI has been much more visible, the majority of individuals would use it as a tool to make things easier. According to a study on students' perception of GAI, text-to-text AI helped students with writing assistance such as ChatGPT. Other tools such as DALL-E and Stable Diffusion helps students in designing and art. These AI tools can do what humans do and at a faster pace. AI tools can also be useful for research (Chan, 2023). As the presence of AI keeps on growing on helping students in trivial tasks such as summarizing, paraphrasing, proofreading, drawing, and more what GAI can do, the presence of GAI is still not a reliable source of reference because it may provide inaccurate and false information such from this from ChatGPT (Bhattacharyya et al., 2023).

Even with the convenience of GAI, some schools do not allow the usage of GAI as it might affect the critical thinking (CT) of students. CT pertains to the intellectual thinking abilities of the person, including judgment, accurate decision-making, problem-solving, analysis, reading comprehension, and scientific and creative thinking. The six dimensions of CT are interpretation, analysis, explanation, self-regulation, evaluation, and inference (Chusni et al., 2020).

The effect of GAI use on the critical thinking skills of high school students are not yet explored by the researchers and educators**.** Thus, this investigation was conducted to understand whether dependence on AI for information and problem-solving hinders or enhances the ability of high school students to think critically, analyze information, and make informed decisions. Moreover, findings of the study shows that students are moderately using GAI and they have high levels of critical thinking skills. Lastly, the result of the study implies that the use of GAI influences the critical thinking skills of the high school students.

LITERATURE REVIEW

This study is anchored on by the support of the theories on Watson-Glaser's Critical Thinking Skills by Goodwin Watson and Edward Glaser (1965), an Overview of Theory and Concepts on Generative Adversarial Network (2021) by Aggarwal, along with another theory called the Piaget Theory (2019). Watson-Glaser's Critical Thinking Skills states that the ability of a person to develop thinking is developed through a series of day-to-day activities. When people encounter a problem, they think of ways to find solutions on solving those problems in their daily lives (Zulmaulida et al., 2018). On the other hand, Piaget Theory explains that students can handle simple problems requiring problem solving but can only manage tasks substantially. Formal operational thinking where junior high school and senior high school students lie in this area of theory. For the Overview of Theory and Concepts on Generative Adversarial Network (2021), explained that deep learning as a generative model that finds applications in the identification of images, speech analysis, and text digging are deemed as superior in forecasting accuracy and explanations that are provided for behavior being observed (Cuzzolin et al., 2020). While theory of Watson-Glaser's Critical Thinking Skills discusses how critical thinking is developed through external factors in their day-to-day activities. With the incorporation of generative artificial intelligence in their day to day lives, the researchers aim to find out if this technology holds significant relation to one's critical thinking.

Generative Artificial Intelligence (GAI) Use

The term "GAI" is more appropriately used for models that produce new, previously unheard material based on their training data rather than all AI-generated content. Instead of just providing numerical forecasts or rules, these algorithms produce engaging, human-like material that can be consumed (García-Peñalvo, & Vázquez-Ingelmo, 2023). GAI is a type of artificial intelligence that builds new text, image, audio, and video content based on patterns it has discovered in previously existing information (Fruhlinger, 2023). The cost structure of information production may have changed most dramatically with the advent of GAI (De Cremer et. al., 2023). The types of GAI are variational autoencoders (VAEs), generative adversarial networks (GANs), transformers, and large language models (LLMs). With the presence of GAI, students have easier and quicker ways to do their schoolwork or studying. However, GANs are generative modeling artificial intelligence systems that focus on comprehending training instances and probability distributions. They excel at producing high-resolution images and have found success in a variety of scientific applications (Goodfellow et al., 2020). According to Cresswell et al. (2018), one network can be pictured as an art forger and the other as an art expert. This is a typical analogy that works well for visual data.

Critical Thinking

Critical thinking (CT) is referred to as reasoning and thinking that is based on reasoning is known as commonsensical thinking. The processes that make up CT include accurately making decisions and judging a situation with intelligence (Sarigoz, 2012). It involves the processes of information interpretation, analysis, summarization, and evaluation. CT virtues include accuracy, precision, relevance, depth, wideness, logic, importance, and fairness. To think critically is to concentrate on evaluating, organizing, clarifying, creating, prioritizing, or classifying ideas (Treffinger & Isaksen, 2013). According to Chusni et al. (2020) the dimensions of CT are interpretation, analysis, explanation, self-regulation, evaluation, and inference.

Interpretation involves understanding and articulating the meaning or importance of a diverse range of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or criteria (Facione, 2015). Analyzing information involves dividing it down into its basic elements, determining their interrelationships, and organizing them to create a coherent structure or meaning. The process includes distinguishing between facts and opinions, finding claims that support arguments, and isolating relevant search terms (Adams, 2015).

An explanation is the ones that are answering the why questions. In an explanation, there are three features that highlight what an explanation is. Firstly, the gap between knowledge and understanding where this pertains to having knowledge about the given topic but there are still in need of learning it more due to its gaps. Secondly, the feature known as why regress meaning relapsing on asking questions for the given explanation already. Lastly, self-evidencing explanations means to have explained an important part of our reason in belief that our reason is correct (Facione, 2015).

Self-regulation is the intentional monitoring of one's cognitive processes, the components utilized in those processes, and the outcomes produced, especially by employing analytical and

evaluative skills in scrutinizing one's own inferential judgments. The importance of self-regulation lies in being able to assess and enhance their own learning. Students need to be lifelong learners who can critically analyze and assess what they have learned and experienced. Students who lack the capacity to retain endurance and focus will have a much harder time coping inside the educational system (Howley-Rouse, 2023).

Evaluation entails assessing the credibility of expressions reflecting an individual's perception, experience, judgment, or beliefs. It involves collecting and analyzing data regarding the features, activities, and results of a matter. Its goals are to evaluate a matter, increase its efficacy, and/or provide information for programming choices (Wanzer, 2020). Evaluation can be seen as a dynamic process that assesses both one's own and other people's actions in addition to analyzing performances, attitudes, behaviors, and accomplishments linked to several objectives (Wigman, 2022).

On the other hand, inference involves recognizing and gathering necessary components for making logical deductions, crafting assumptions and hypotheses, evaluating pertinent details, and deducing outcomes based on various forms of information such as data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other representations (Claire 2023). Inference is a vital tool that is used in many disciplines, including science, literature, and communication. It helps us analyze circumstances and make smart assumptions, especially when the whole picture is unclear, enabling us to make better decisions.

Furthermore, we also face challenges on GAI relating to its limitations and issues on ethics, plagiarism, and academic integrity. In a study by Warschauer et al., (2023), it was found that overreliance on GAI tools may compromise students' genuine efforts to develop writing competence. In Chan and Tsi's (2023) study, there is a particular concern towards holistic competency development such as creativity and critical thinking. The benefits of GAI underline the potential of the technology as a valuable learning tool for students, while its limitations and challenges show a need for research into how GAI can be effectively integrated in the teaching and learning process.

In a study conducted by Ahmad et al. (2023) for university students from Pakistan and China, the data analysis findings showed that AI significantly impacts the loss of human decision-making and makes humans lazy. The multigroup analysis result showed that difference in gender or sex is not significant in any of the relationships tested (JMP Statistical Discovery LLC, 2023).

METHODS

Descriptive-correlational research design was applied in this study to describe and find the influence of generative artificial intelligence use to critical thinking skills of high school students at Adventist University of the Philippines during school year 2023-2024. A total of 166 students was gathered randomly from grades 7 to 12 to be the respondents of the study.

A combination of adapted and modified questionnaires based on ideas from existing studies and related literature were utilized for this study. The set of questions were revised by the researchers to suit the current topic and the characteristics of the study population. The Generative Artificial Intelligence Use Questionnaire (GAIUQ) was adapted from Gozalo-Brizuela and Garrido-Merchán (2023), which determined the extent of usage of GAI tools of high school students. A 5-Point Likert scale ranging from 5 (Always) to 1(Never) was used in five

item questions. Critical Thinking Skills Questionnaire (CTSQ) determined the level of the respondents' critical thinking skills. A 5-Point Likert scale ranging from 5 (Strongly Agree) to 1 (Strongly Disagree) and a total of 36 questions was utilized to measure each dimensions of the critical thinking skills. This part of the survey was adapted from Teo et al. (2023).

An online survey using google form and face to face using printed survey question are applied to gather the data necessary to answer the research inquiries. Table 1 presents the reliability of each subscale of the instruments used and were determined through Cronbach Alpha. It shows that the instrument for GAI use is excellent and instruments for critical thinking with its dimensions is good.

Table 1

Reliability of Generative Artificial Intelligence use and Critical Thinking Scale

Variables	Number of Items	Cronbach Alpha	Verbal Interpretation
Generative Artificial Intelligence Use	5	0.948	Excellent
Critical Thinking			
Interpretation	6	0.876	Good
Analysis	6	0.881	Good
Explanation	6	0.889	Good
Self-Regulation	6	0.840	Good
Evaluation	6	0.879	Good
Inference	6	0.892	Good

The institutional Ethics Review Board [ERB] of the school gave consent to the proposed study. Anonymity and confidentiality were observed during the entire study. Descriptive statistics of mean and standard deviation were employed to assess the levels of CT and extent of usage of GAI. Pearson Product Moment Correlational Coefficient was utilized to find out the relationship between GAI usage and high school students' CT skills. Linear Regression Analysis was applied the find the strength of influence of GAI use to CT.

RESULTS AND DISCUSSION

Tables 2 presents the extent of generative artificial intelligence use of the respondents. The result of the study shows that the respondents use generative artificial intelligence *moderately* with a mean of 3.45 and standard deviation of 0.97. This implies that the students moderately use GAI to do their research work, collaborative discussion or learning, and other academic requirements.

Table 2

Extent of Generative Artificial Intelligence Use of High School Students

	M	SD	Scaled Response	Verbal Interpretation

Generative Artificial Intelligence Use	3.45	0.97	Moderately Agree	Used Moderately

Legend: **1-1.49**=Strongly Disagree; **1.50-2.49**=Disagree; **2.50-3.49**=Moderately Agree; **3.50-4.49**=Agree; **4.50-5**=Strongly Agree

According to Bancoro (2024) many students moderately use generative artificial intelligence to enhance their knowledge learning experiences as also stated by Chan and Lee (2023). Through the emergence in the Asia-Pacific region, the use of generative AI can impact the different learning interests and needs of students including those with disabilities. It can make education accessible as possible for learners with diverse needs on learning (UNESCO, 2023). It gives huge opportunities for a student's learning experiences to be enhanced and addressed. Although, it's lack of pedagogical systems which may lead to passive learning and loss of learning (Abdelghani et al., 2023).

Table 3 presents the level of the respondents' critical thinking skills with its dimensions. With an overall mean of 3.98 (SD = 0.54), respondents assessed their level of critical thinking as *high*. The dimensions such as self-regulation (mean=4.06; SD=0.65), analysis (mean=4.05; SD=0.63), inference (mean=4.04; SD=0.64), interpretation (mean=3.97; SD=0.64), evaluation (mean=3.94; SD=0.64), and explanation (mean=3.81; SD=0.66) are also *high*. The result implies that the students can interpret their lessons, can express their thoughts, they can explain the problems in given topic, and they can make a reasonable assumption for effective solutions.

Table 3
Critical Thinking Level of the Respondents

	M	SD	Scaled Response	Verbal Interpretation
Self-Regulation	4.06	0.65	Agree	High
Analysis	4.05	0.63	Agree	High
Inference	4.04	0.64	Agree	High
Interpretation	3.97	0.64	Agree	High
Evaluation	3.94	0.64	Agree	High
Explanation	3.81	0.66	Agree	High
Critical Thinking (*overall mean***)**	3.98	0.54	Agree	High

Legend: **1-1.49**=Strongly Disagree; **1.50-2.49**=Disagree; **2.50-3.49**=Moderately Agree; **3.50-4.49**=Agree; **4.50-5**=Strongly Agree

The result of this study is consistent with Demir's (2022) which states that high school students have high order thinking skills, analytical thinking skills, and critical thinking dispositions. Self-regulation enhances the ability of social relations and can be used as a medium for guidance counseling services. It can also improve the counseling services on a student's self-regulation of social relationships. Another thing that plays a role in a student's self-regulation is their environment that supports their success in regulating themselves (Bancin et al., 2019).

In essence, this highlights that evaluation encompasses the critical examination of both subjective perspectives and the coherence of different forms of communication. With this, students can write their own version of their essay choosing the ideas from themselves and with

the help of the chatbots generating the short essay from the questions asked (Aithal & Silver, 2023).

The findings of the study on how students' usage of generative artificial intelligence associates with their critical thinking is shown in Table 4. With association coefficients of 0.416 (p =.000), usage of generative artificial intelligence *significantly influences* critical thinking. The dimensions of critical thinking such as analysis (r=0.378; p=0.000), explanation (r=0.447; p=0.000), evaluation (r=0.309; p=0.000), inference (r=0.304; p=0.000), interpretation (r=0.277; p=0.000), and self-regulation (r=0.410; p=0.000) are also *influenced* using generative artificial intelligence. The link is *moderately positive*, which suggests that use of generative artificial intelligence is more likely help students to think critically.

Table 4
Relationship between Generative Artificial Intelligence Use and Critical Thinking with Its Dimensions

	Pearson Correlation	**Significance**	**Verbal Interpretation**
Analysis	0.378**	.000	Significant
Explanation	0.447**	.000	Significant
Evaluation	0.309**	.000	Significant
Inference	0.304**	.000	Significant
Interpretation	0.277**	.000	Significant
Self-Regulation	0.410**	.000	Significant
Critical Thinking	0.416**	.000	Significant

* *Correlation is significant at the 0.01 level (2-tailed).

The result of this study supports the claim of the published study of Essien et. al. (2024) where their empirical data showed that ChatGPT positively impacts the student's ability to remember, understand and apply (basic level), as well as their analysis and evaluation (advance level). Connecting this to English foreign language students who also used ChatGPT in classroom assignments and homework. This data shows that English foreign language students are commonly in use of ChatGPT for their language studies (Tahiri, 2024).

The linear regression analysis with critical thinking as the dependent variable is shown in Table 5. The use of generative artificial intelligence accounts for 17.3% of the variability in critical thinking with F(1, 166) =34.2, p<0.001, R^2=.173, and R=.415 which increase in the variability of 16.8%. This result implies that students' critical thinking is attributed by generative artificial intelligence use.

Table 5
Regression Analysis of High School Students' Critical Thinking

Constant	Unstandardized Coefficients		Standardized Coefficients					Adjusted
	B	Std. Error	Beta	t	Sig	R	R^2	R^2

(Constant)	3.138	.144		21.737	.000			
Use	.236	.040	.415	5.849	.000	.415	.173	.168

Predictor: (Constant), Use

Bancoro (2024) reported a positive correlation between AI usage and academic performance of students which related to the findings of this study that use of AI can enhance the critical thinking skills of the students.

CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

The respondents demonstrated moderate use of generative artificial intelligence tools and their critical thinking skills, measured across various dimensions, showed consistently high levels, suggesting that even with moderate usage of AI, students are adept at employing critical thinking strategies. Additionally, study findings reveal a significant positive correlation between the use of generative artificial intelligence tools and the critical thinking skills of high school students. Furthermore, the linear regression analysis indicates that a substantial portion of the variation in students' critical thinking skills can be attributed to their use of generative AI tools.

This study suggested that teachers should not discourage the use of generative artificial intelligence tools for the students for academic purposes and performance. It can also cater to different learning styles of a student which generative artificial intelligence can do. Moreover, educators should design learning experiences that encourage students to engage with AI tools in ways that promote higher-order thinking, such as analysis, evaluation, and inference. Researchers can conduct additional research that incorporates the different types of generative artificial intelligence. They can also explore on the differences of se and age is on the critical thinking of high school students.

This study is limited only to the high school students at Adventist University of the Philippines during school year 2023-2024. The study does not compare the type of GAI use and age level of the students and how these affect their critical thinking with its dimensions because of time constraints. In addition, the researchers have decided that only Generative Adversarial Networks (GAN) and Large Language Models (LLM) are applied in this study as the other types are not applicable and unlikely utilized by high school students of Adventist University of the Philippines.

REFERENCES

Abdelghani, R., Sauz'eon, H., & Oudeyer, P. (2023). Generative AI in the classroom: Can students remain active learners. https://www.semanticscholar.org/paper/Generative-AI-in-the-Classroom%3A-Can-Students-Remain-Abdelghani-Sauz'eon/080e00c681e0e2aebb72758233a1d2bfe64b6930

Adams, N. (2015). Bloom's taxonomy of cognitive learning objectives. *Journal of the Medical Library Association*, 103(3), 152–153. https://doi.org/10.3163/1536-5050.103.3.010

Aggarwal, A., Mittal, M., & Battineni, G. (2021). Generative adversarial network: An overview of theory and applications. *International Journal of Information Management Data Insights*, *1*(1), 100004. https://doi.org/10.1016/j.jjimei.2020.100004Sc

Ahmad, S. F., Han, H., Alam, M. M., Rehmat, M. K., Irshad, M., Arraño-Muñoz, M., & Ariza-Montes, A. (2023, June 9). Impact of artificial intelligence on human loss in decision making, laziness and safety in education. *Humanit Soc Sci Commun 10, 311.* https://doi.org/10.1057/s41599-023-01787-8

Aithal, V., & Silver, J. (2023, March 30). *Enhancing learners' critical thinking skills with AI-assisted technology*. World of Better Leaning. https://www.cambridge.org/elt/blog/2023/03/30/enhancing-learners-critical-thinking-skills-with-ai-assisted-technology/

Armstrong, P. (2010, June 10). Bloom's taxonomy. *Vanderbilt University*. https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Bancin, K. B., Mudjiran, M., & Rusdinal, R. (2019). Development of guidance and couseling on self-regulation of students in social relations. https://www.semanticscholar.org/paper/Development-of-guidance-and-counseling-module-on-of-Bancin-Mudjiran/d215b637c3691a0407000c1416a0606ca9dc5d38

Bancoro, J. C. M. (2024). The relationship between artificial intelligence (AI) usage and academic performance of business administration students. *International Journal of Asian Business and Management,* 3(1), 27–48.https://journal.formosapublisher.org/index.php/ijabm/article/view/7876

Bhat, A. (2023, November 24). *Descriptive correlational: Descriptive vs correlational research.QuestionPro.* https://www.questionpro.com/blog/descriptive-research-vs-correlational-research/#:~:text=Descriptive%20correlational%20research%20is%20a,is%20a%20link%20between%20them.

Bhattacharyya, M., Miller, V. M., Bhattacharyya, D., & Miller, L. E. (2023). High rates of fabricated and inaccurate references in ChatGPT-generated medical content. *Cureus.* https://doi.org/10.7759/cureus.39238

Chan, C. K. Y., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *International Journal of Educational Technology in Higher Education*, *20*(1). https://doi.org/10.1186/s41239-023-00411-8

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education, 20(1).* https://doi.org/10.1186/s41239-023-00408-3

Chan, C. K. Y., & Tsi, L. H. Y. (2023). The AI revolution in education: Will AI replace or assist teachers in higher education. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2305.01185

Chan, C. K. Y., & Lee, K. K. W. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers. *Smart Learning Environments*, *10*(1). https://doi.org/10.1186/s40561-023-00269-3

Chassignol, M., Хорошавин, A. B., Klímová, A., & Bilyatdinova, A. (2018). Artificial intelligence trends in education: A narrative overview. *Procedia Computer Science, 136, 16–24.* https://doi.org/10.1016/j.procs.2018.08.233

Chusni, M. M., Saputro, S., Suranto, S., & Rahardjo, S. B. (2020). The potential of discovery learning models to empower students' critical thinking skills. *Journal of Physics*, *1464*(1), 012036. https://doi.org/10.1088/1742-6596/1464/1/012036

Claire, J. (2023, November 5). *What is an inference. Definition & 10+ Examples*. Enlightio. https://enlightio.com/inference-definition-examples?fbclid=IwAR1OmM7cH13IOVkRwpQoAm6LZzgWkeZubpD0j7YbPPmdwyWtrbrAiU2s8gQ

Cuzzolin, F. et al. (2020). Knowing me, knowing you: Theory of mind in AI. *Psychological Medicine*, 32375908.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7253617/

Critical Thinking | Stanford Encyclopedia of Philosophy. (2018). https://plato.stanford.edu/entries/critical-thinking/#exam-rash

Davisson, E., & Hoyle, R. (2017). The Social-Psychological Perspective on Self-Regulation. in *The Wiley Handbook of Cognitive Control*.

De Cremer, D. (2023, April 14). How generative AI could disrupt creative work. *Harvard Business Review*. https://hbr.org/2023/04/how-generative-ai-could-disrupt-creative- work?fbclid=IwAR2fINsh39st-wynAbRu_SK8G53ftvwD2bGYrEL2oLP6WA- FzwymH_KCD4w

Demir, E. (2022). An examination of high school students critical thinking dispositions and analytical thinking skills. *Journal of Pedagogical Research*. https://doi.org/10.33902/jpr.202217357

Essien, A., Bukoye, O. T. & O'Dea, X. & Kremantzis, M. D. (2024). The influence of AI text generators on critical thinking skills in UK business schools. Studies in Higher Education. https://www.tandfonline.com/doi/full/10.1080/03075079.2024.2316881

Explanations : Styles of Explanation in Science: EBSCOHost. (2004). https://web.p.ebscohost.com/ehost/detail/detail?vid=2&sid=63e0e2a4-2a54-45c0-8da9-b7670d6ab4aa%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=437167&db=e000xww

Facione, P. (2015). *Critical thinking: What it is and why it counts. ResearchGate*. https://www.researchgate.net/publication/251303244_Critical_Thinking_What_It_Is_and Why_It_Counts

Facione, P. A. (1990) *The Delphi report critical thinking: A statement of expert consensus for purposes of educational assessment and instruction* https://www.qcc.cuny.edu/socialSciences/ppecorino/CT-Expert-Report.pdf

Fruhlinger, J. (2023, August 7). What is generative AI: Artificial intelligence that creates. InfoWorld. https://www.infoworld.com/article/3689973/what-is-generative-ai-artificial- int elligence-that-creates.html

Goodfellow, I. J., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., & Bengio, Y. (2020). Generative adversarial networks. *Communications of the ACM*, *63*(11), 139–144. https://doi.org/10.1145/3422622

Gozalo-Brizuela, R., & Garrido-Merchán, E. C. (2023, June 5). *A survey of generative AI applications*. arxiv.org. https://arxiv.org/abs/2306.02781. Help me Grow MN. https://helpmegrowmn.org/HMG/HelpfulRes/Articles/WhatCognitiveDev/index.html

Howley-Rouse, A. (2023, October 11). The importance of self-regulation for learning. *The Education Hub*. https://theeducationhub.org.nz/self-regulation/

JMP Statistical Discovery LLC (2023, February 27). Multiple-Group analysis in structural equation modeling. https://community.jmp.com/t5/JMP-Blog/Multiple-Group-Analysis-in-Structural-Equation-Modeling/ba-p/604714#:~:text=Multiple%2Dgroup%20analysis%20(MGA),with%20equal%20estimates%20across%20groups

Kobylarek, A., Błaszczyński, K., Ślósarz, L., & Madej, M. (2022). Critical Thinking questionnaire: Construction and application of critical thinking test tool. *Andragogy*, *2*(2), 1. https://doi.org/10.15503/andr2022.1

Sarıgoz, O. (2012). Assessment of the high school students' critical thinking skills. *Procedia - Social and Behavioral Sciences*, *46*, 5315–5319. https://doi.org/10.1016/j.sbspro.2012.06.430

Tahiri, Z. (2024). English as a foreign language students' usage of Chat Generative Pre-trained Transformer in the classroom and homework Assignments. *Proceedings of The International Conference on Research in Teaching and Education*. https://doi.org/10.33422/rteconf.v1i1.171

Teo, C., Wang, X., Tan, S. C., & Lee, J. W. Y. (2023). Enhancing critical thinking in operations management education: a framework with visual-based mapping for interdisciplinary and systems thinking. *Higher Education Pedagogies*, *8*(1). https://doi.org/10.1080/23752696.2023.2216388

Thompson, P. (2019, August 15). *2.1 Cognitive Development: The Theory of Jean Piaget*. Pressbooks.https://open.library.okstate.edu/foundationsofeducationaltechnology/chapter/2-cognitive- development-the-theory-of-jean-piaget/#:~:text=Piaget%20proposed%20four%20major%20stages,(4)%20formal%20operational%20thinking.

Thormundsson, B. (2024, January 25). Generative artificial intelligence (AI) *Statistics & facts*. *Statista.* https://www.statista.com/topics/10408/generative-artificial-intelligence/?fbclid=IwAR1IL275aMUbVN6xFtS6UVYGUMNC6d65OKEy2-jPwWfUUfo1T2Z8x_0eVFM#topicOverview

Treffinger, D. J., & Isaksen, S. G. (2013). *Teaching and Applying Creative Problem Solving: Implications for At-Risk Students.* https://eric.ed.gov/?id=EJ1301380

UNESCO. (2023, November 23). How generative AI is reshaping education in Asia-Pacific. *Unesco*. https://www.unesco.org/en/articles/how-generative-ai-reshaping-education-asia-pacific#:~:text=This%20interactive%20process%20makes%20learning,for%20learners%20with%20diverse%20needs.

Warschauer, M., Tseng, W., Soobin, Y., Webster, T. J., Jacob, S., Du, Q., & Tate, T. (2023). The affordances and contradictions of AI-generated text for writers of english as a second or foreign language. *Journal of Second Language Writing*, *62*, 101071. https://doi.org/10.1016/j.jslw.2023.101071

Wanzer, D. J. (2020). What is evaluation: Perspectives of how evaluation differs (or not) from research. *American Journal of Evaluation/˜the œAmerican Journal of Evaluation*, *42*(1), 28–46. https://doi.org/10.1177/1098214020920710

West, S. (2024, April 1). *How to use artificial intelligence in the critical thinking process: enhancing human decision-making*. Critical Thinking Secrets. https://criticalthinkingsecrets.com/how-to-use-artificial-intelligence-ai-in-the-critical-thinking-process/#google_vignette%20%20pa%20cite%20ni2

Wigman, L. (2022, January 4). *Evaluation definition, classification, objectives and characteristics*. *Collaborative Research Group (CRG).* https://crgsoft.com/evaluation-definition-objectives-and characteristics/?fbclid=IwAR2QO4csiPbDVNCePIvWKbCNqeNnEOsgGQqQukCXy5fwyHpkNAUaRgXZoS4

Zulmaulida, R., Wahyudin, & Dahlan, J. A. (2018). Watson-Glaser's critical thinking skills.*Journal of Physics*, *1028*, 012094. https://doi.org/10.1088/1742-6596/1028/1/012094