



Fostering Critical Thinking: Strategies and Insights from Diverse Fields- A Survey

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Article History

Received: 11.05.2024

Accepted: 03.06.2024

Published: 08.06.2024

Abstract: This survey looks at ways to encourage critical thinking, drawing ideas from fields like education, psychology, business, and technology. Critical thinking is crucial for evaluating information, making informed decisions, and solving complex problems. The study reviews different methods for teaching and improving critical thinking, such as problem-based learning, Socratic questioning, and digital tools. It aims to identify and address research gaps, which can greatly enhance the development of critical thinking skills. By combining insights from various disciplines, the survey provides a thorough overview of effective techniques and highlights best practices for educators and professionals. The findings indicate that using multiple approaches, tailored to the specific context and needs of learners, is the most effective way to foster critical thinking.

Keywords: Critical Thinking, 21st century skills, Inquiry-based learning, Education.

Cite this article:

Soumyamol C. A., Smitha S., (2024). Fostering Critical Thinking: Strategies and Insights from Diverse Fields- A Survey. *ISAR Journal of Multidisciplinary Research and Studies*, 2(6), 12-18.

Introduction:

Critical thinking is an essential ability in professional settings, academic, and personal spheres, involving the ability to logically and effectively analyze, assess, and interpret data or circumstances. This skill entails challenging assumptions, drawing logical conclusions, and approaching problems methodically. Critical thinkers are adept at examining multiple perspectives, evaluating available data, and applying logic to arrive at well-informed judgments. By relying more on logic and evidence rather than presumptions or biases, critical thinkers enhance their ability to communicate clearly, make informed decisions, and adapt to changing circumstances.

Beyond being a cognitive process, critical thinking is an attitude towards the intellectual challenges of life. It fosters open-mindedness, acceptance of diverse viewpoints, and a willingness to engage in thoughtful inquiry. This mindset involves questioning underlying assumptions and facts rather than accepting things at face value. Enhancing critical thinking skills requires practice and engagement in thought-provoking activities. These skills include identifying logical fallacies, evaluating arguments, distinguishing facts from opinions, and drawing valid conclusions from available data. Acknowledging the significance of these abilities for success in both educational settings and broader life contexts, educational systems increasingly emphasize their development among students.

Rationale of the Study

Review papers serve as invaluable resources for both newcomers and experts in a field, offering a comprehensive overview of prior research while identifying key discoveries, theoretical advancements, and methodological approaches. By synthesizing existing scholarship, these papers not only fill knowledge gaps but also provide critical insights into current

understanding and future research directions. Through meticulous examination and evaluation of past studies, review papers contextualize research issues within broader scholarly discussions, highlighting their significance and paving the way for further investigation. Moreover, they ensure methodological rigor by drawing from established theories and avoiding pitfalls encountered in earlier research. Ultimately, review papers contribute to the advancement of knowledge by fostering a logical and cumulative process of scholarly inquiry.

Objective of the Study

To conduct a comprehensive literature review and synthesis of research articles on a specific topic to identify trends, patterns, and gaps in existing research.

Methodology

1. Identification of Research Articles-
2. Searched for relevant research articles published within a specific timeframe using academic databases like PubMed, Google Scholar, and Web of Science.
3. Selection Criteria-
 - Included peer-reviewed research articles published in reputable journals.
4. Data Extraction-
 - Extracted relevant details such as title, publication year, research methodology, key findings, and theoretical frameworks used.

Analysis and Synthesis of the collected data

Presentation of Results

Table-1**Brief description of the papers surveyed on the Critical Thinking and Problem Solving Skills**

No	Title of Study	Publisher	Year	Design selected	Method /Techniques	Tool used	Type of Research
1.	The effect of Instructional Techniques on Critical Thinking Dispositions in Online Discussion	Educational Technology and Society	2014	Triangulation Design	Six Thinking hats, Brainstorming , Role playing, Socratic Discourse, Seminar	Assessment Materials per Technique	Mixed-Methods Research
2.	Purposely Teaching for the Promotion of Higher – order Thinking Skills: A case of Critical Thinking	Research in Science Education	2007	Pre-post and post-post experimental Design	Longitudinal case study	Critical Thinking Assessment Instruments	Experimental Research
3.	Effecting change on student’s Critical Thinking in Problem Solving	EDUCARE International journal for Educational Studies	2018	Experimental Design	Technique of creating Problem Situations	Four problem situations were given	Experimental Research
4.	Problem Based Learning to Increase Competence of Critical Thinking and Problem Solving	Journal of Education and Learning (EduLearn)	2020	Action Research	Observation	Multiple-Choice Written Test	Action Research
5.	Determine the relationship between the Disposition of Critical Thinking and the Perception about problem Solving Skills	Procedia-Social and behavioural Sciences	2015	Descriptive Studies Correlational Model	Survey	California Critical Thinking Disposition Inventory, Problem solving Skills Inventory	Correlational Research
6.	Computer-aided argument mapping in an EFL setting: does technology precede traditional paper and pencil approach in developing critical thinking	Springer	2016	Experimental Research	Testing	Reading Proficiency test, California critical thinking skills test (CCTST)	Experimental Research
7.	The Perception of Critical Thinking and Problem Solving Skill Among Malasian Undergraduate Students	Procedia-Social and behavioural Sciences	2015	Descriptive Research	Survey	Questionnaire	Descriptive Research
8.	Enhancing Students’ Computer Programming Performances, Critical Thinking Awareness and Attitudes towards Programming: An Online Peer-Assessment Attempt	Journal of Educational Technology & Society	2017	Quasi experimental study	Peer Assessment	Programming Knowledge Tests, Programming Skill Test, Questionnaires of Learning Attitude and Critical Thinking	Quasi-Experimental Research
9.	Critical Thinking and Problem Solving Skills: How these Skills are needed in Educational Psychology?	International Journal of Science and Research (IJSR)	2017	Quasi Experimental	Testing	Achievement Test	Quasi-Experimental Research

10.	Critical Thinking and Problem Solving Skills in Mathematics of Grade-7 Public Secondary Students	Asia Pacific Journal of Multidisciplinary Research	2017	Descriptive-Co relational Study	Survey	Critical Thinking Skills Test, Problem Solving Skills Test, Questionnaire	Correlational Research
11.	The Impact of Problem-Solving Programs In Developing Critical Thinking Skills	European Chemical Bulletin	2023	Quasi experimental	Testing	Critical Thinking Scale	Quasi-Experimental Research
12.	Effects of problem-based learning vs. traditional lecture on Korean nursing students' critical thinking, problem-solving, and self-directed learning	Nurse Education Today	2014	Non equivalent control group pre test– post test design	Testing	Critical Thinking Ability Scale for College Students	Quasi-Experimental Research
13.	Problem Solving Attitude And Critical Thinking Ability Of Students	International Journal of Research	2020	Descriptive Design	Survey	Rating Scale Questionnaire (Ranganath Pandit), Critical Thinking Skill Assessment (Alan Castle)	Descriptive Research
14.	The effects of problem-based learning on pre-service teachers' critical thinking dispositions and perceptions of problem-solving ability	South African Journal of Education	2014	Experimental Design (A pre-test-post-test control group design)	Survey	California Critical Thinking Disposition Inventory, Problem-Solving Inventory	Experimental Research
15.	Investigating Critical Thinking in Prospective Teachers: Meta cognitive Skills, Problem Solving Skills and Academic Self-Efficacy	Journal of Social Studies Education Research	2019	Correlational Survey model	Survey	Critical Thinking Disposition Scale, Metacognitive Skills Scale, Problem Solving Inventory, Academic Self-Efficacy Scale	Correlational Research
16.	Investigating pre-service science teachers' critical thinking dispositions and problem solving skills in terms of different variables	Educational Research and Reviews	2011	Descriptive	Survey	California Critical Thinking Disposition Inventory, Problem Solving Inventory	Descriptive Research
17.	Investigating Critical Thinking Skill of Junior High School in Solving Mathematical Problem	International Journal of Instruction	2019	Descriptive Research	Mixed Methods	Test, Interviews	Descriptive Research
18.	Assessing Change in Student Critical Thinking for Introduction to Sociology Classes	Teaching Sociology	2013	Experimental Study	Testing	SOLO Taxonomy Scale	Experimental Research
19.	Integrating direct and inquiry-based instruction in the teaching of critical thinking: an intervention study	Instructional Science(Springer)	2014	Experimental Design	Testing	Halpern Critical Thinking Assessment, Need for Cognition Scale	Experimental Research
20.	Collaborative Problem Solving Methods towards Critical Thinking	International Education Studies,(Publisher	2011	Quasi Experimental Design	Testing	Cornell CT Level X Test (CCT-X)	Quasi-Experimental Research

		: Canadian Center of Science and Education/ERIC)					
21.	Improving Fifth-Grade Students' Mathematical Problem-Solving and Critical Thinking Skills Using Problem-Based Learning	Universal Journal of Educational Research	2020	Quasi Experimental Design	Testing	Problem-Solving Skills Test (PSST), Critical Thinking Skills Test (CTST)	Quasi-Experimental Research
22.	Examining the Relationship between Pre-Service Teachers' Critical Thinking Disposition, Problem Solving Skills and Teacher Self-Efficacy	International Education Studies	2017	Correlational Research	Survey	California Critical Thinking Disposition Inventory, Problem Solving Scale, Teacher Self-Efficacy Scale	Correlational Research
23.	The Effectiveness of Multiple Intelligences Based Collaborative Problem Solving to Improve Critical Thinking	Jurnal Kependidikan Penelitian Inovasi Pembelajaran	2019	Experimental Design	Testing	Watson Glaser Critical Thinking Appraisal Test, Multiple Intelligences Questionnaire, Observation Sheet, Mastery Test Concept of Salt Hydrolysis	Experimental Research
24.	The Effect of Problem-based STEM Education on the Students' Critical Thinking Tendencies and Their Perceptions for Problem Solving Skills	Science Education International	2022	Mixed Method Research (Qualitative and Quantitative)	Mixed Methods	Critical Thinking Tendency Scale, Perception Scale for Problem Solving Skill, Semi-Structured Interview, Form Experience Diaries	Mixed-Methods Research
25.	A Comparative Study on Critical Thinking of Mathematical Problem Solving using Problem Based Learning and Direct instruction	Atlantis Press	2020	Quasi-Experimental Research	Testing and Survey	Test, Questionnaire	Quasi-Experimental Research

Discussion and Implications:

Discussion:

The table presents a comprehensive overview of research studies focusing on skills in critical thinking and problem-solving across various educational contexts. A common theme across these studies is the recognition of the importance of these cognitive skills in education and their potential effect on student educational results. The diverse range of research designs and methods employed highlights the multidimensional nature of investigating skills in analytical thinking and problem-solving. From experimental designs to correlational studies, each approach offers unique insights into the factors influencing the development and assessment of these skills.

The first study aimed to assess the effectiveness of instructional techniques regarding critical thinking in online discussions using a triangulation design. While the quantitative analysis showed no significant difference between groups except for Socratic Seminar, qualitative findings suggested the Mixed Techniques

group demonstrated the highest critical thinking skills, followed by the Anyone Here an Expert group, and lastly, the Brainstorming group.

In the second study, employing a longitudinal case study approach, researchers investigated the impact of teaching methods designed to boost higher-level thinking abilities in science education. The results showed significant enhancements in critical thinking skills and attitudes within the experimental group compared to the control group. Particularly, noticeable improvements were noted in aspects like seeking truth, open-mindedness, self-assurance, and maturity.

In the third study, researchers examined how changes impact students' critical thinking in mathematics problem-solving using real-world scenarios. The study utilized an experimental approach. The findings revealed that incorporating problem situations improved students' critical thinking abilities in problem-solving tasks.

In the fourth study, the focus is on achieving effective learning outcomes in analytical thinking and problem-solving abilities. The study emphasizes the need for interventions to attain

these goals. Observation is utilized in this classroom action research design to gauge competence development, acknowledging the limitations of multiple-choice written tests in assessing deep learning outcomes.

The fifth study investigates the correlation between critical thinking disposition and perception towards problem-solving skills among learners. Employing a descriptive correlational model, the research finds a moderate positive significant relationship between pre-service music teachers' disposition toward critical thinking and perceptions about problem-solving.

The sixth study compares the impact of teaching argument mapping using Rationale™ software versus traditional paper and pencil methods on critical thinking skills in Iranian EFL majors. Over 12 sessions, experimental groups receive instruction in argument mapping, while the comparison group follows conventional reading instruction. Results reveal that students using the software significantly outperform those using paper and pencil on the overall California Critical Thinking Skills Test (CCTST).

The seventh study explores students' perceptions of their critical thinking and problem-solving skills and examines differences based on gender and academic discipline. Data is collected through surveys, showing that students generally perceive themselves as having strong critical thinking and problem-solving skills. Male students tend to excel in these abilities, and social science students outperform peers in science and engineering.

In the eighth study, researchers propose an online peer-assessment approach for computer programming activities and develop a corresponding system. After analyzing the data from a high school Scratch programming course, it is found that students using the online peer-assessment approach outperform those following conventional teaching methods in various aspects, including critical thinking awareness and learning attitude.

The ninth study assesses students' critical thinking and problem-solving abilities in an educational psychology lecture. Employing a quasi-experimental method with a Randomized Control Group Post-test design, the analysis indicates a need for improvement in these skills.

The tenth study examines the academic performance, critical thinking skills, and problem-solving abilities of Grade-7 students in public secondary schools. Findings reveal proficient mathematics performance, above-average critical thinking and problem-solving skills, and a positive correlation between mathematics performance and these cognitive abilities.

In the eleventh study, researchers evaluated the efficacy of a problem-solving curriculum within the Optimal Investment Program to enhance critical thinking skills among learners. Their findings indicated a significant improvement in critical thinking abilities among the experimental group, attributed to advancements in identifying and controlling variables, testing hypotheses, and reasoning.

Moving to the twelfth study, scholars explored the impact of Problem-Based Learning (PBL) on critical thinking, problem-solving, and self-directed learning among Korean nursing students. Through a quasi-experimental approach, they discovered that the PBL group exhibited improvements across all measured abilities,

while the traditional lecture group experienced declines in problem-solving and self-directed learning.

The thirteenth study investigated the correlation between students' problem-solving attitudes and critical thinking abilities. Results suggested a notable association, indicating that students with positive problem-solving attitudes tended to employ effective critical thinking strategies to tackle challenges adeptly.

In the fourteenth investigation, pre-service educators demonstrated a notable deficiency in critical thinking disposition, alongside a moderate level of perception regarding their problem-solving abilities. Findings revealed that while both problem-based learning and conventional teaching methods yielded similar effects on pre-service educators' critical thinking dispositions, they diverged in their impact on perceptions of problem-solving ability.

The fifteenth study delves into the correlation between prospective educators' meta-cognitive skills, problem-solving aptitude, academic self-efficacy, and their tendencies toward critical thinking. Outcomes unveiled a noteworthy, moderate-level positive association between critical thinking tendencies and meta-cognitive skills, as well as academic self-efficacy. These factors elucidated approximately half of the variance in critical thinking tendencies. However, problem-solving skills did not significantly contribute to elucidating critical thinking tendencies.

The sixteenth inquiry delved into comprehending the critical thinking dispositions and problem-solving skills of pre-service science instructors, taking into account variables such as gender, grade level, and the type of high school attended. Notably, significant disparities surfaced in critical thinking disposition levels based on gender and high school type. However, concerning the correlation between critical thinking dispositions and problem-solving skills, no noteworthy variances were observed concerning gender and grade level.

The seventeenth examination utilized descriptive research to scrutinize junior high school students' critical thinking abilities in mathematics, focusing on facets like analysis, evaluation, inference, explanation, and self-regulation. Employing qualitative methods, including tests and interviews, the research unveiled a general deficiency in students' critical thinking skills, with evaluation, analysis, and self-regulation emerging as the least mastered sub-skills.

In the eighteenth study, experiments were conducted across four sections of introductory sociology classes. Employing a design incorporating pre-tests and post-tests to assess students' critical thinking skills, the findings underscored a noteworthy positive impact on critical thinking skills among the experimental group by the semester's end. This improvement was attributed to the integration of writing assignments and classroom discussions aimed at nurturing creative thinking processes. Consequently, students transitioned from simplistic, one-dimensional thinking to more intricate, multi-structural analysis.

The nineteenth investigation delved into the influence of three instructional modes on enhancing critical thinking performance among Chinese secondary students. Utilizing pre- and post-intervention measures with 651 Grade 12 students, the study revealed that participants who underwent training exhibited greater enhancements in critical thinking assessments compared to those

who did not, underscoring the advantages of employing diverse instructional approaches in teaching critical thinking.

The twentieth study explored the impact of collaborative problem-solving methods on critical thinking among lower sixth-form students, differentiating between economy-based (AE) and non-economy-based (TE) approaches. Through a quasi-experimental design involving 294 students from ten schools, outcomes indicated that students in the KPMs1 group, particularly those with an economy-based approach, attained the highest mean scores in critical thinking, as evidenced by the Cornell Post-Test.

The twenty-first study aimed to enhance the mathematical problem-solving and critical thinking abilities of fifth-grade students through problem-based learning in an Indonesian elementary school. Employing a quasi-experimental design, students underwent assessment with Problem-Solving and Critical Thinking Skills Tests. Data analysis utilizing One-Way MANOVA and ANOVA at a .05 significance level revealed that the experimental group surpassed the control group in post-test scores for both skills. Consequently, problem-based learning emerged as an effective method in bolstering students' problem-solving and critical thinking capacities.

The twenty-second investigation scrutinized the interrelations between pre-service teachers' critical thinking disposition, problem-solving skills, and self-efficacy beliefs, utilizing statistical methodologies such as arithmetic mean, Pearson correlation, and multiple regression analysis. Findings unveiled that while critical thinking disposition was low, problem-solving skills were moderate, and self-efficacy was adequate. Both critical thinking and problem-solving demonstrated significant correlations with and positively predicted all facets of teacher self-efficacy. This suggests that enhancing these skills could bolster pre-service teachers' confidence in their instructional capabilities.

The twenty-third study delved into the impact of the Multiple Intelligences-based Collaborative Problem-Solving (MI-CPS) strategy on students' critical thinking, mathematical logical intelligence, and comprehension of chemical concepts. Employing stratified random sampling, students were divided into experimental (MI-CPS strategy) and control (conventional methods) groups. Statistical analyses, encompassing percentage techniques, chi-square tests, one-way ANOVA, and multiple correlation tests, indicated that the experimental group significantly outperformed the control group in all assessed domains. This underscores the efficacy of the MI-CPS strategy in enhancing critical thinking, mathematical logical intelligence, and understanding of chemistry concepts.

The twenty-fourth examination explored the effects of problem-based STEM activities on middle school students' perceptions of their problem-solving skills and critical thinking tendencies. Employing a mixed-method approach, one-way ANOVA of quantitative data showcased that experimental groups held significantly better perceptions.

The final study pits two teaching methods against each other: problem-based learning and direct instruction. Researchers wanted to see which approach led to students developing stronger critical thinking skills when tackling math problems. They set up a non-equivalent control group design, essentially creating two separate classrooms with different teaching methods. After analyzing the data (including checking for normality, homogeneity, and using a t-test), the results were clear: problem-based learning came out on top. Students in

those classrooms showed a greater improvement in their ability to think critically when solving math problems compared to those who received direct instruction.

Implications of the Study

The findings from these studies have important implications for education. They highlight the need for instructional strategies that enhance critical thinking and problem-solving skills, such as problem-based learning, collaborative problem-solving, and computer-aided argument mapping. Effective assessment tools like the California Critical Thinking Disposition Inventory and Problem-Solving Inventory can evaluate intervention success and track student progress. The link between critical thinking and problem-solving underscores the need to integrate these skills into curricula and teacher training. Overall, these insights are valuable for educators, policymakers, and researchers aiming to foster these essential skills in students.

Conclusion

This study offers an in-depth overview of techniques and strategies meant to develop critical thinking in a variety of academic fields. The paper explores the definition and use of critical thinking in the domains of education, psychology, and philosophy. It then identifies and discusses ways for fostering critical thinking skills, such as inquiry-based learning, active learning, and reflective practices. It also highlights how technology and multidisciplinary cooperation can improve critical thinking skills. The study provides educators and practitioners with helpful recommendations on fostering critical thinking within their particular areas by combining concepts from multiple fields.

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