



Unleashing The Power Of Curiosity : A Game-Changer For Effective Problem-Solving

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Introduction

Curiosity is an essential human trait that fuels exploration, discovery, and problem-solving. When students are curious, they are more engaged, interested, and motivated to explore and learn. Cultivating curiosity, particularly in the context of problem-solving, has been recognized as a crucial factor for maximizing success. This study aims to identify the strategies that can be employed to nurture and enhance curiosity in problem-solving scenarios. Curiosity and problem – solving are closely intertwined , with curiosity serving as a catalyst for effective problem- solving skills. Curiosity is a desire to understand something that is not yet known or understood , and it plays a crucial role in various domains , including education , research and creativity . by fostering , individuals can enhance their problem – solving abilities and approach challenges with a sense of wonder and exploration. Curiosity is a desirable attribute of a fully developed person, and is commonly depicted as an early appearing , albeit fragile, feature of young children’s orientation toward the world .

Objective of the study: The main objective of study was to identification of relationship between curiosity and problem solving ,explore effective strategies for cultivating curiosity in problem-solving processes. By examining various approaches and techniques, this study seeks to identify methods that can optimize the learners curiosity levels, leading to enhanced problem-solving abilities

What is role of curiosity in learning

Curiosity is a motivator for learning , influential in decision making and crucial for healthy development (kidd et.al. 2015). Children’s curiosity is often expressed by asking questions and we understand that the , more questions asked , more curious a child is (jirout& Klahr , 2012) . Curiosity is reflected in approaching and exploring novel stimuli , which makes it a potentially important ingredient of innovation and problem-solving(Damerius et.al. ,2017). Curiosity can be caused by different factors , including the need for sense-making, the need for cognition, the aversion to ambiguity ,and the salience of specific missing information (jirout& Klahr , 2012).

Country	Researcher	Platform	Findings
United states	jirout& Klahr , 2012	Elsevier	Children's curiosity is often expressed by asking questions and the more questions asked , the more curious a child is.
switzerland	Damerius et.al. ,2017	Elsevier	Motivation towards the acquisition of novel information and thus an attraction towards learning and experiencing something new .
United states	jirout& Klahr , 2012	Elsevier	Curiosity can be caused by different factors , including the need for sense- making, the need for cognition, the aversion to ambiguity ,and the salience of specific missing information
switzerland	Damerius et.al. ,2017	Elsevier	Curiosity is reflected in approaching and exploring novel stimuli , which makes it a potentially important ingredient of innovation and problem-solving.
Indonesia	Ardani et al. , 2022	Google scholar	Curiosity is a natural feelings for humans , especially children.
Germany	Werlen & Hirt, 2019	Google Scholar	Curiosity implies promotion of learning , empirical evidence .

Problem- Solving

Problem solving skill , the ability to understand the problem , choose a strategy and implement the solution of the given problem (Zetriuslita et al.,2017) . Problem solving is lead by the epistemic curiosity which is motivation driven by desire for knowledge , learning new ideas , and resolving information-gaps (Jirout & Klahr , 2012).

Country	Researcher	Platform	Findings
Canada	Zetriuslita et.al. 2017	Elsevier	Problem solving skill , the ability to understand the problem , choose a strategy and implement the solution of the given problem.
Turkey	Karademir , 2019	Elsevier	Problem solving is the foundation of a young childs learning. Problem solving is a skill that can be learned and must be practiced .problem solving also includes ,curiosity and being a researcher.problem solving skills and a high level of curiosity are very important in terms of educating students with the same characteristics.
United states	Jirout & Klahr , 2012	Elsevier	Problem solving is lead by the epistemic curiosity which is motivation driven by desire for knowledge , learning new ideas , and resolving information-gaps.

Method

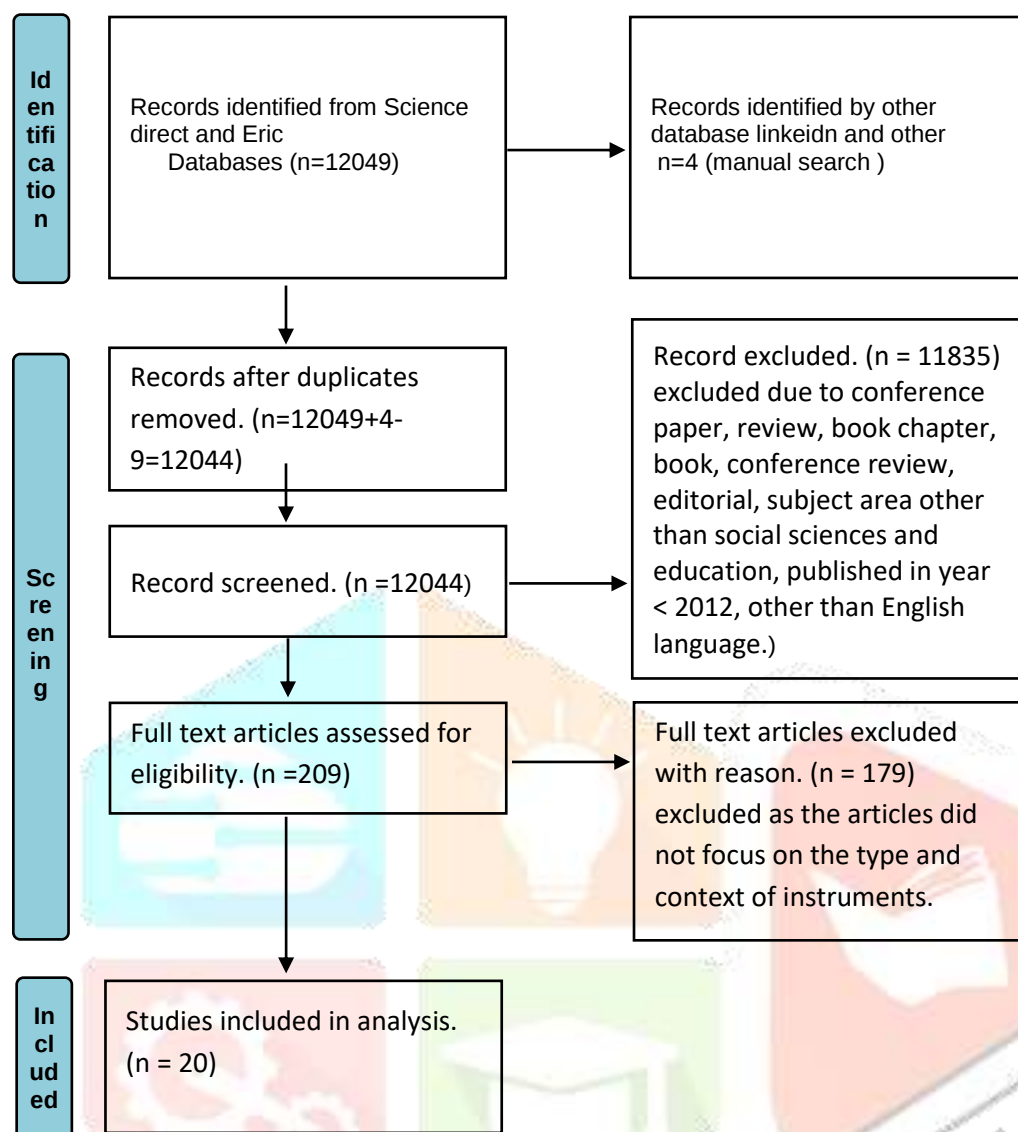
The study was conducted through a systematic review method. The method started with formulating the research questions, followed by three systematic strategies: identification, screening and eligibility. Finally, the data were extracted and analysed. Two research questions were formulated to frame this study: (1) what is the relationship between curiosity and problem solving? (2) what are various approaches and strategies for cultivating curiosity in problem solving?

The keywords used to do the searching were “relationship between curiosity and problem solving”, “cultivating curiosity”, “curiosity and problem solving”. The selected main indexing database were Science Direct, Google Scholar and Eric. In addition, articles were used from other databases like LinkedIn to complement the search.

The four stages of the selecting process as shown in fig 1, adapted from PRISMA. In the identification process, the result from the main database was 12049 and from manual searching in complementary was 4. In total, 12049 articles were retrieved in the first stage. 9 duplicated articles from the main and complementary database were removed.

Three remaining 12044 articles were screened based on several inclusion and exclusion criteria. The first criteria was the literature type. The review focused on the reviewed journal article and research article. The conferences paper, review, book chapter, book, conference view, and the editorial were excluded. The second criterion was the publication date. Articles before year 2012 were excluded. The last criterion in the screening process was the publication language. Only articles in English were included. 11835 articles did not fit the criterion and were excluded.

Consequently, 209 articles were proceeded for eligibility stage. The title, abstract and the main content of the articles were examined to ensure the conformation of the inclusion criteria to attain the objectives of study. Consequently, 179 articles were excluded as they were not focused on the type and also the content of instruments. Finally 20 articles were analysed. The data were extracted to elaborate the research questions.



Relationship between Curiosity and problem solving

Gyger (2021) noted that curiosity is a mindset that , when applied correctly , can be incredibly powerful for problem-solving. However ,curiosity takes humility, and it is essential to approach problems with an open mind to find innovative solutions. According to Edutopia article (2023) It stressed on the the importance of small-scale curiosity in problem-solving among middle and higher school students. Encouraging students to apply their curiosity to problem-solving involves presenting them with interesting problems that are worth the effort of arriving at a solution. The Buisness journal (2017) says that curiosity allows us to listen to others and understand who they are , which is essential for problem-solving in social situations. Solesbee (2022) define curiosity as the desire to fill in knowledge gaps caused by ambiguity or uncertainty is referred to as curiosity.. it suggest that curiosity is similar to critical thinking and active learning , and it can promote – problem – solving in various domains of knowledge. Hardy et al. (2017) reveals that diversive curiosity, specifically epistemic curiosity associated with interest factors, has a positive influence on creative performance .This is fully mediated by information-seeking behavior during early-stage creative problem solving. The researchers found that curiosity was the sole predictor of problem solving performance(Damerius et.al. ,2017; Karademir ,2019).

Country	Researcher	Platform	Findings
United states	Mitch Gyger,2021	Linkedln article	curiosity is a mindset that , when applied correctly , can be incredibly powerful for problem-solving. However ,curiosity takes humility, and it is essential to approach problems with an open mind to find innovative solutions.
california	Emma Chiapetta,2023	Edutopia article	It emphasizes the importance of small-scale curiosity in problem-solving among middle and higher school students. Encouraging students to apply their curiosity to problem-solving involves presenting them with interesting problems that are worth the effort of arriving at a solution.
America	Harvey Mackay ,2017	The Buisness Jornals	It suggest that curiosity allows us to listen to others and understand who they are , which is essential for problem-solving in social situations.
Morocco	Ashley solesbee,2022	Participate learning article	It define curiosity as the desire to seek information to address knowledge gaps resulting from uncertainty or ambiguity . it suggest that curiosity is similar to critical thinking and active learning , and it can promote – problem –solving in various domains of knowledge.
United states	Hardy et al. (2017)	Elesiver	It reveals that diversive curiosity, specifically epistemic curiosity associated with interest factors, has a positive influence on creative performance . This is fully mediated by information-seeking behavior during early-stage creative problem solving
switzerland	Damerius et.al. ,2017	Elsevier	This study conducted a variety of task aimed at assessing physical cognition , including reversal learning , inhibitory control , causal reasoning , and tool use, to investigate how response –and exploration style and previous experiences affected an individual's problem-solving performance. The researchers found that curiosity was the sole predictor of problem solving performance .The effect of curiosity on the probability of solving a problem varied significantly.
Turkey	Karademir ,2019	Eric	The scale totals and all sub dimensions of the problem-solving inventory, or "curiosity scale," were subjected to a Kolmogrov-Smirnov test. Skewness values ranged from +1 to -1, whereas kurtosis values ranged from +2 to -1. Multivariate analysis of variance (MANOVA) was used to analyze the data since the established skewness and kurtosis values are acceptable limit values where it demonstrates normal distribution and additional assumptions

			were made. Following analyses, Tukey HSD from post-hoc tests were used to look at the origin of the difference between the groups. In order to determine problem solving skills and curiosity levels, frequency , arithmetic mean and standard deviation values were calculated . Pearson correlation analysis was made to determine there is a significant between problem solving skills and curiosity levels.
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Explore approaches ,methods and strategies for cultivating curiosity in problem-solving processes.

According to Jirout and Klahr (2012) there are several approaches to enhance curiosity by providing novel and challenging experiences that stimulate curiosity and promote exploration , encouraging active learning and inquiry-based approaches that allow learners to ask questions and seek answers, fostering a supportive learning environment that values curiosity and encourages risk-taking, providing opportunities for self-directed learning and exploration, using technology and multimedia to create engaging and interactive learning experiences , encouraging collaboration and social interaction to promote the sharing of ideas and perspectives , providing feedback and recognition for curiosity and exploration, encouraging reflection and metacognition to help learners understand their own thinking processes and promote self- regulated learning. Understanding the nature of curiosity can help educators design more effective learning environment that foster curiosity and promote learning (Jirout & Klahr , 2012). The effective strategies for cultivating curiosity in children are : encouraging exploration and discovery , asking open- ended questions , providing hands-on experiences , fostering a growth mindset , modeling curiosity (Jirout & Klahr , 2012) . Educators can promote curiosity by creating a sense of mystery or intrigue around a topic , by highlighting the gaps in learner's knowledge , and by providing opportunities for learners to generate their own questions and hypotheses. Educators can help learners develop their curiosity themselves, by providing opportunities for learners to explore their own interests , and by encouraging learners to take risk and pursue their own questions and interest (Jirout & Klahr , 2012). Study also found that the effects of social interactions, environmental stimulation, and experiences during ontogeny on problem –solving success were all indirect : they affected the individual's curiosity , which in turn affects an individual's problem-solving ability. Curiosity was especially effective when solving problems for which trial and error can lead to solution (Damerius et.al. , 2017 ; Leo et al. , 2019).

Country	Researcher	Platform	Findings
United states	jirout& Klahr , 2012	Elsevier	there are several approaches to enhance curiosity by providing novel and challenging experiences that stimulate curiosity and promote exploration , encouraging active learning and inquiry-based approaches that allow learners to ask questions and seek answers, fostering a supportive learning environment that values curiosity and encourages risk-taking, providing opportunities for self- directed learning and exploration, using technology and multimedia to create engaging and interactive learning experiences , encouraging collaboration and social interaction to promote the sharing of ideas and perspectives , providing feedback and recognition for curiosity and exploration, encouraging reflection and metacognition to help learners understand their own thinking processes and promote self-regulated learning.
United kingdom	Graham & Helen, 2011	The university of sheffield	One approach is inquiry –based learning , which involves encouraging students to ask their own questions and investigate topics that interest them ,another approach is to present students with “information gaps” or areas of knowledge that they do not yet know, which can motivate them to seek out answer and actively engage with the material.simple classroom techniques such as posing thought –provoking questions or using multimedia to capture students’ attention.
Canada	Zetriuslita, et al (20170	Eric	Based on Mann-Whiteny –U , the gain mean of Mathematical curiosity attitude of Experimental class is 0.09 and control class is 0.03 . which shows that both experimental and control classes have different gain average of Mathematical curiosity attitude . furthermore , a statistical test was to find out the significance of the variance difference by using software SPSS version 20.00 . The Lavene –test yields sig=0.81> α , with $\alpha=0.05$. the testing criterion accept H_0 , which means that both classes have homogeneous variance. So , t-test was used to find out equal variance assumption and obtained sig(2-tailed)= 0.40 >= α , accepted H_0 , meaning that there is no different increase in mathematical curiosity between experiment and control classes.
United states	Jirout and Klahr, 2012	Elsevier	The effective strategies for cultivating curiosity in children are : encouraging exploration and discovery , asking open-ended questions ,providing hands-on experiences , fostering a growth mindset , modeling curiosity .
switzerla nd	Damerius et.al ,2017	Elsevier	The study suggest that providing a safe and stimulating physical and social environment may be important for cultivating curiosity and also found that effect of social interactions, environmental stimulation, and experiences on problem solving success were all indirect : they affected the individual curiosity , which in turn affects an individual problem solving ability .
Indonesia	Ardani et al.	Google	The application of media and use of appropriate learning

	, 2022	scholar	models, activities , way can increase students curiosity and problem solving and make students active in learning and achieve learning goals .
Germany	Werlen & Hirt, 2019	Google Scholar	Mood and curiosity had a positive influence on mental effort and learning performance during problem- solving .
Indonesia	Yusuf,2019	Google scholar	The quality of the problem presented in learning can also have an effect on students curiosity . encouraging students to ask questions ,gather information, and explore various things that have not yet been answers can also enhance their curiosity . In problem –based learning students are given space to analyze problems, find out the cause of problems , think of alternative solutions , and try out their ideas , which can also enhance their curiosity .
Indonesia	Hasanah , et.al. , 2021	Google Scholar	Based on the analysis of the answers and interview with the high epistemic curiosity students , it could be concluded that the students reached the indicator of problem solving skill based on NCTM and were able to solve the questions systematically based on polya stages . when the problem solving strategy was emphasized in learning environment then the students discussed it with their peers , their skills in problem solving would improve .
Indonesia	Susilowati et al. 2020	Google Scholar	Problem –based learning activities can lead to students curious attitude . The use of media or technology in learning can stimulate curiosity . Therefore , incorporating hands-on activities and technology in problem- solving activities can be effective strategies to enhance curiosity in problem solving .

Conclusion

The findings emphasize the importance of creating an environment that fosters questioning, providing hands-on learning experiences, and promoting intrinsic motivation. By implementing these strategies, individuals, educators, and organizations can harness the power of curiosity to drive innovation, creativity, and successful problem-solving. Childrens' curiosity is often expressed by asking questions , and reflected in approaching and exploring novel stimuli , promotion of learning (Jirout & Klahr , 2012 ; Werlen & Hirt, 2019; Damerius et.al. ,2017). Curiosity can be caused by different factors like need for sense-making , need for cognition , aversion to ambiguity and the salience of specific missing information . Problem solving is lead by the epistemic curiosity which is motivation driven by desire for knowledge , learning new ideas , and resolving information-gaps (Jirout & Klahr , 2012).

The paragraph discusses the importance of curiosity in problem-solving. It emphasizes that curiosity, when applied correctly, can be incredibly powerful for problem-solving. However, it also mentions that curiosity requires humility and an open mind to find innovative solutions. The paragraph highlights the significance of small-scale curiosity in problem-solving among middle and high school students and suggests that presenting interesting problems can encourage students to apply their curiosity. It defines curiosity as the desire to seek information to address knowledge gaps resulting from uncertainty or ambiguity. The paragraph also mentions that diversive curiosity, specifically epistemic curiosity associated with interest factors, positively influences creative performance. The paragraph concludes by mentioning a study that found curiosity to be the sole predictor of problem-solving performance, with the effect of curiosity on the probability of solving a problem varying significantly

Zetriuslita, et al(2017) found that problem –based learning and cognitive conflict strategy (PBLCCS) can improve students mathematical critical thinking skill, it has not improved their mathematical curiosity attitude . Therefore , to improve their mathematical curiosity in learning , students need to get accustomed to PBLCCS practices . The learning instruments (LKM) used should be more focused so that it can increase students MCT (Mathematical critical thinking) skill .

To enhance curiosity, various approaches can be employed, including novel experiences, active learning, inquiry-based learning, fostering a supportive learning environment, self-directed learning, technology and multimedia, collaboration, social interaction, feedback, and reflection. Inquiry-based learning encourages students to ask questions and explore topics, while information gaps motivate active engagement. Classroom techniques like thought-provoking questions and multimedia capture students' attention. Results show that both experimental and control classes have different gains in mathematical curiosity attitude, with no significant difference in increase between the two classes.

Result and discussion

The research findings highlighted several key strategies for cultivating curiosity in problem-solving i.e. creating an environment that encourages questioning and exploration was found to be crucial. This involves encouraging questioning, providing opportunities for exploration, using open-ended problems, and celebrating curiosity. Similarly, providing opportunities for hands-on learning and experiential problem-solving was found to be highly effective. Engaging in real-world problem-solving scenarios, whether individually or collaboratively, enhances curiosity by stimulating curiosity-driven inquiry and experimentation.

Educators can promote curiosity by creating a sense of intrigue, highlighting gaps in knowledge, and providing opportunities for learners to generate their own questions and hypotheses. They can help learners develop their curiosity themselves by exploring their interests and encouraging them to take risks. Social interactions, environmental stimulation, and experiences during ontogeny affect problem-solving success indirectly, affecting individual curiosity. Effective strategies for cultivating curiosity include presenting interesting problems, fostering a positive learning environment, encouraging questioning and exploration, promoting intrinsic motivation, and emphasizing problem-solving processes.

Providing a safe and stimulating physical and social environment is crucial for cultivating curiosity. The application of media and appropriate learning models can increase students' curiosity and problem-solving abilities. The quality of the problem presented in learning can also affect students' curiosity. Problem-based learning allows students to analyze problems, find the cause, think of alternative solutions, and try their ideas, enhancing their curiosity.

Incorporating hands-on activities and technology in problem-solving activities can be effective strategies to enhance curiosity in problem-solving.

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