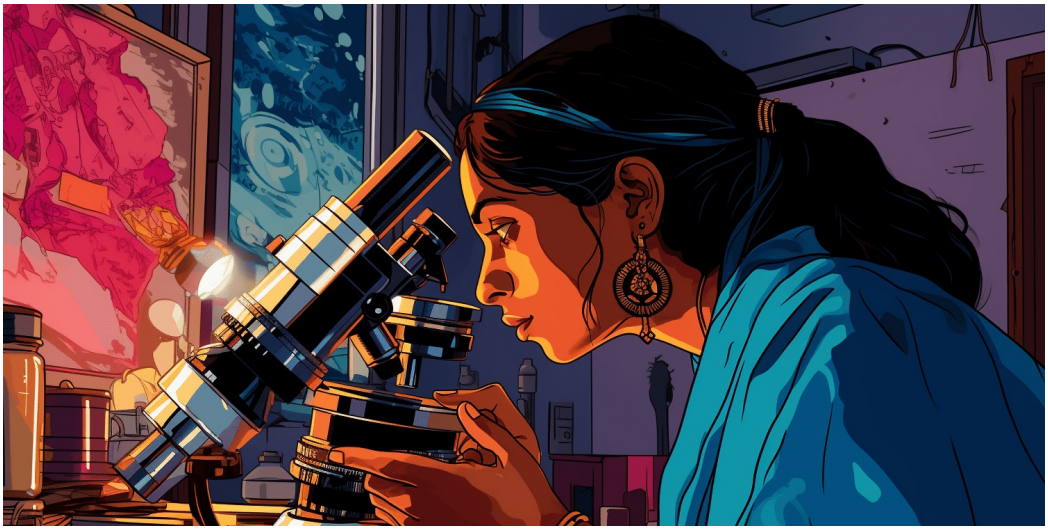

Does a ‘Creativity Crisis’ Truly Exist Among Science Learners?

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Abstract

The study aimed to understand the change in science learners’ creative potential from the perspective of their teachers. It was explored through changes in a few important factors of creativity - Ideation, Intrinsic motivation, Self-efficacy, and grit. The study was conducted through a web-based descriptive survey using a questionnaire. The samples consisted of teachers in India who teach science at various degree colleges and universities. The analysis of the data revealed that the creative potential of science learners has improved over the years, thus reducing the creativity crisis, with the exception of grit, which has shown a downward trend.

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Introduction

For educational psychologists, creativity has always been an interesting field of study due to its direct implications on pedagogy. This interest has grown even more in recent times (Hennessey & Amabile, 2010) as modern pedagogy aims to develop the creative behavior of learners. The world economy is now transforming into a knowledge-based economy, where innovation and idea generation play crucial roles instead of traditional assets like land, labor, and finance. This has made creativity and economic development highly related (Howkins, 2001). As a result, many developed and developing nations have started to invest in curricula that are conducive to creativity (Pllana, 2019) in order to improve the creative potential of learners. Creative potential is described as the latent ability above which an individual behaves creatively, and it requires a confluence of many resources from different social, cognitive, and environmental domains (Barai & Saha, 2021; Sterberg, 2012). The questions that arise now are how well such curricula are contributing to developing the creative potential among science learners?

Background of the Study

An intriguing study by Kim (2011) concerning children in the US studying at different grade levels revealed that over the past 20 decades, the scores of the Torrance Test of Creative Thinking (TTCT) have decreased. This leads to a conflicting scenario where, despite an increase in the world's affluence, improvements in nutrition, social well-being, and educational reforms, creativity among members of society is decreasing. This creativity crisis motivated the researcher to study the current situation in India. Thus, this study was conducted to understand if science learners in India are also becoming less creative over time.

Studies conducted by Kapur et al. (1997) explained that the 'Indian behavior,' characterized by emotional upbringing, emotional bonding, lack of self-guidance, overreliance on others, and an inability to understand oneself and their goals, restricts Indian people from being creative in science. Educators or teachers are the individuals who work to nurture and improve the creative potential of learners. They observe the learners very closely, making it wise to examine any possible

creativity crisis from their perspective. The present study explored the change in the creative potential of Indian learners from the teacher's perspective because, unlike learners in the US who have a sound database of TTCT, there is insufficient empirical data available on Indian learners.

Significance of the Study

After the implementation of the national curriculum framework (NCF-2005), science education was given more importance with a special focus on making it contextual, joyful, and interactive through activity-based learning (Barai, 2018). This was aimed to foster creative thinking among science learners, and teachers were encouraged to introduce methods like problem-solving, divergent thinking, and brainstorming to the learners, as these could help in fostering the scientific creative potential of the students (Gupta & Sharma, 2019). The present study will, therefore, help to understand the current situation of science learners regarding their creative potential and behavior in comparison to students who graduated in the past. It will also reveal the resources of creativity that are essential for the change in creative behavior among science learners.

Objectives of the Study

The two prime objectives of the study are: (a) To study the creative potential of science learners in comparison to those who graduated earlier. (b) To study how the underlying resources of creativity contribute to the change in the creative potential of science learners.

The Study

This study used an indirect way of assessing the observation of teachers teaching science learners to understand their change in creative potential and the responsible resources of creativity. The study used a descriptive survey method, which is the most suitable research method to understand any phenomenon. The survey was conducted online, and a questionnaire was prepared in Google form, which was sent to the participants through email. The first section of the questionnaire was carefully constructed to assess four different traits among science learners - Ideation, Intrinsic Motivation, Self-efficacy, and Grit. There were 30 items in the questionnaire with 8 items each for ideation, intrinsic motivation, and grit, whereas there were 6 items for self-efficacy. The items were phrased to reflect how much the new students of science are different in comparison to the older students in relation to the above-mentioned factors. An example of an item under the ideation trait is, *"I found my newer students are more capable of combining different ideas than the older students.'* The items were scored on a 5-point Likert scale ranging from 'strongly disagree -1' to 'strongly agree -5'. The mean of each factor represented the score for that factor, and the score was criterion-based, so a score between 2.5 to 3.4 represents a moderate degree of the trait, and a score above 3.5 represents the presence of a high degree of that factor.

The second section of the questionnaire was designed as a semi-structured interview that consisted of 7 close-ended questions and 1 open-ended question to understand the students' creative attitude and behavior.

Variables

Ideation is the ability of an individual to generate multiple ideas; it is often considered the same as divergent thinking, but unlike divergent thinking, it represents the overt actions and skills with ideas of an individual (Runco et al., 2001). Thus, it is considered as a factor of creative potential.

Intrinsic motivation is the behavior driven by internal urge, and it is another important resource for creativity, which is essential for an individual to produce a creative product (Prabhu et al., 2008). Thus, it is also a factor of creative potential (Amabile, 1983).

Self-efficacy is the people's confidence and belief in their ability to influence the events that affect their lives (Bandura, 2010). Self-efficacy in science is the belief of the learners to do well and satisfactorily in science. Self-efficacy in academics was found to be correlated with creativity, making it another factor of creative potential among the learners (Shaabani et al., 2012).

Grit is the never-give-up attitude of an individual and the passion for achieving long-term goals (Duckworth et al., 2007). However, it has been found that grit does not predict creative behavior (Grohman et al., 2017). Thus, the change of factors - ideation, intrinsic motivation, self-efficacy, and grit - was studied in this research to explain the possible change in the creative potential of science learners.

Participants and Data Collection

The participants were science teachers teaching at various educational institutes. For the same, purposive sampling was done, and the invitation was sent to the participants through their institutional email. The interested participants voluntarily participated through Google form. Following research ethics, the participants' identities were kept anonymous. A total of N=92 responses were collected for the study. The demographic information of the participants is given in Table 1.

Table 1. Demographic Information of the Participants

Gender	Percentage	Age Group (in years)	Percentage	Teaching experience (in years)	Percentage	Institution	Percentage
Male	77.1	20-29	9.80	Less than 5	18.45	Undergraduate College	41.30
Female	21.7	30-39	38.04	5-10	34.78	University	21.74
Prefer not to say	1.1	40-40	28.26	11-15	17.39	IIT/NIT/IISC/IISER	32.61
		50-59	19.57	16-20	13.04	Other engineering colleges	4.35
		60+	4.35	21-25	7.61		
				26-30	5.43		
				31 & above	3.26		

IIT- Indian Institute of Technology, NIT- National Institute of Technology, IISC- Indian Institute of Science, IISER- Indian Institute of Science Education and Research

Data Analysis and Results

The data were analyzed using SPSS v.22 software since various parametric statistics were used for analysis. Firstly, the normality of the data was checked, and it was found that the skewness value and kurtosis value of all the factors were between -2.0 and +2.0, indicating normally distributed data (as shown in Table 2).

Table 2. Descriptive Statistics

Factors	N	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Ideation	92	2.82	.88	.34	.25	.15	.49
Intrinsic Motivation	92	2.88	.84	.21	.25	.32	.49
Self-efficacy	92	2.94	.95	.04	.25	-.08	.49
Grit	92	2.63	.84	.47	.25	.43	.49

The data obtained from the first section of the questionnaire showed that the mean of grit was low compared to the other factors, as seen in Table 2. Next, three pairs (1, 2, and 3 as shown in Table 3) were prepared for comparing the other factors of resources with grit. The mean score of grit was significantly lower when compared to the other three factors, as shown in Table 3. Therefore, apart from grit, the current generation of learners has significantly higher ideation, motivation, and self-efficacy.

Table 3. Paired Sample t-test of Factors

		Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
							.002*
Pair 2	Intrinsic motivation-Grit	.25	.65	.07	3.67	91	.00*
Pair 3	Self-efficacy - Grit	.31	.71	.07	4.18	91	.00*

* *P < 0.05*

In Table 4, a gender-wise t-test revealed that there was no difference of opinion between the male and female teachers. Similarly, two groups of teachers were prepared: one with experience below 10 years in teaching, labeled as ‘less experienced teachers,’ and the other with more than 10 years of teaching experience, labeled as ‘more experienced teachers.’ Table 5 revealed that there was no difference of opinion between the more experienced and less experienced teachers. Thus, they unanimously consider the present generation of students more creative than older generations.

Table 4. Gender-wise t-test: Male vs. Female

Factors	t	df	p	Mean Difference	Std. Error
Ideation	-.11	89	.91	-.02	.23
Intrinsic Motivation	-1.43	89	.16	-.30	.21
Self-efficacy	-.33	89	.74	-.08	.24
Grit	-.45	89	.65	-.09	.21

Table 5. Experience-wise t-test: Less Experienced Teacher vs. More Experienced Teacher

Factors	t	df	p	Mean Difference	Std. Error
Intrinsic Motivation	.57	90	.57	.10	.18
Self-efficacy	1.51	90	.13	.29	.20
Grit	.94	90	.35	.17	.18

The second section of the questionnaire was designed to understand the behavior of newer students in the classroom in order to explain the findings of the first section of the study. So, a simple statistical and content analysis of the responses was done. In Table 6, the closed-ended questions are given along with the responses made by the teachers.

Table 6. Responses of the Participants from the Semi-structured Interview

Questions	Yes	No	Cannot decide
Q1) Do you think the newer generation of students are less competitive to their classmates/friends in comparison to old students?	15.22%	67.39%	17.39%
Q2) Do you think that collaborative learning among the students in a class (with their classmates or friends) has increased by the passing of academic years?	53.26%	36.96%	9.78%
Q3) Do you think that in comparison to the older students nowadays, friendship among the new students is ruled by 'need' rather than 'intimacy'?	68.47%	15.22%	16.30%
Q4) The newer generation of students in comparison to old ones has huge resources of knowledge. Do you think the newer students are more capable of organizing these pieces of information and know-how to learn from them?	47.83%	46.73%	5.34%
Q5) With the passing of academic years, the students are becoming more competent in deciding their goals and planning a way to achieve them. Do you agree with it?	63.04%	25.00%	11.96%
Q6) Do you think newer students in comparison to the old students are very good at self-evaluation, like by rethinking 'how I would have done this task more appropriately'?	35.87%	52.17%	11.97%
Q7) Do you think your classroom environment is conducive to developing the creative potential of the students?	76.08%	23.91%	---------
(Q.8) Write a few points in support of your above response in Q.7. (open-ended question)			

These responses helped us understand the reasons behind the higher creative potential of the newer generation of learners compared to the older students. In response to Q1, 67.39% of teachers responded negatively, revealing that the newer generation of students was very competitive in the classroom. In Q2, 53.26% of teachers agreed that newer students practiced collaborative learning more than the older ones, which could possibly help improve their creative behavior, as some literature emphasizes a strong relationship between the two (Turnbull et al., 2010). Q3 showed that, according to teachers, the current generation of students was less affectionate towards friends, and they formed friendships based on their needs. This indicates that the traditional 'Indian behavior' of overemotional attachments, as described by Kapur et al. (1997), is changing and probably contributing to the creative behavior of science learners. The response to Q4 was inconclusive. With a 63.04% positive response in Q5, it was evident that newer students were excellent at deciding their goals and planning to achieve them. Surprisingly, in Q6, self-evaluation among the new learners, which is an important element of metacognition, was low, and this might be hindering their creative potential passively. Lastly, in Q7, 76% of teachers supported the statement that their classrooms were conducive to the creative potential of the science learners, indicating that the classroom behavior and environment were supporting the present generation of science learners by fostering creative potential.

In question 8, the teachers were asked to provide a few points in support of their response to Q7. This open-ended question helped us better understand the classroom environment that, according to teachers, was helping the newer students build their creative potential. Fewer teachers who were against the statement of Q7 (23.9%) reported that reasons such as a lack of proper teacher-learner ratio, inferior infrastructure, poor curriculum, huge syllabus load, too much emphasis on grades/marks, and lack of proper training among teachers to nurture creativity were hindering creativity in their classrooms. The majority of teachers who claimed their classrooms were conducive to developing creative potential among learners reported that allowing the learners to interact freely in the classroom, encouraging group discussions, flexible learning, and joyful contextual learning helped them a lot. Encouraging problem-solving methods, seminars, projects, assignments, and wall magazines also played a significant role in fostering creative potential.

Conclusion

In countries like the USA, studies conducted by researchers (Kim, 2011) have shown a decline in the creative potential of learners. In the case of India, during the first few decades after independence, the creative contribution in science and technology was not significant. Literature suggests that typical Indian behavior was one of the main reasons behind this reluctance to go beyond the usual limits and underestimating their potential (Kapur et al., 1997). However, the present condition of contribution to the domain of scientific creativity in India has improved compared to a couple of decades ago. The current study revealed that in the last couple of decades, the generation of science learners in India exhibited moderately high levels of ideational behavior, intrinsic motivation, and self-efficacy, but significantly less grit compared to much older students. This pattern is desirable for creative science learners, as science learners shouldn't need grit to be creative (Barai & Saha, 2022). Despite insufficient infrastructure in Indian educational institutes, which posed challenges to fostering the creative potential of science learners, teachers reported that simple teaching-learning methods such as free interaction, collaborative learning, open seminars, projects, problem-solving, and joyful learning were helping nurture the creative potential of science learners in their classrooms by influencing their ideation, motivation, and self-efficacy.

This study also revealed the importance of teachers in identifying the strengths and weaknesses of the science learners for enhancing their creative potential. The science teachers must be oriented through proper in-service courses to develop abilities for psychological understanding of their students. This will help them to identify those resources of creativity of the student that specifically contribute towards scientific creative potential. Also, knowing the proper methods and practices of teaching-learning will give the teachers tools to make their classroom conducive to scientific creativity.

Further studies could be done in future to understand the other possible resources of scientific creative potential like environmental factors (home, parenting style, socio-economic status, friend groups, etc.) that may have changed over the years to positively or negatively affect the creativity of the present generation of science learners. This will obviously help to develop curriculum and teaching-learning practices that will make science learners more creative and the teachers more motivated towards promoting creative behavior of the learners in their classroom.

Link to Data Repository

SPSS SAV FILE: https://drive.google.com/file/d/1CiDvC5cMnDsCMYAHNYX-_hjEda55Q0c6/view?usp=sharing

Link to the Questionnaire

https://forms.gle/qTzLbFCGxtJSCjAH7

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