Institutional Pre of Stem/steam Learning In Paredness for the Integration in Punjab

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Abstract

STEM (science, technology, engineering, and mathematics) approach is becoming more and more popular on a global basis as it focuses a strong emphasis on science, technology, engineering, and mathematics, Technology. Finding out how prepared Punjab educational institutions are to integrate STEM and STEAM education into their respective curricula is the main objective of the study that will be discussed in this article. As several educational institutions spread out over Punjab's province, questionnaires and interviews were conducted in order to collect data for the study. The majority of the inquiries concerned the ease of use of various resources, the level of education attained by the teachers, and the state of the infrastructure. The research's findings show that while interest in STEM and STEAM education is growing in Punjab, there is still insufficient funding, inadequate teacher preparation, and insufficient infrastructure to support it. This is true despite the fact that interest in the topic is rising. Despite the fact that interest in the subject is growing, this is the current state of affairs. In order to increase institutional readiness for the integration of STEM and STEAM education, the government of Punjab and educational institutions should invest in resources, teacher preparation programs, and infrastructure, in accordance with the study report's recommendations. To improve institutional readiness for the integration of STEM and STEAM education, certain expenditures should be made. In Punjab, there is a growing interest in STEM/STEAM education, but the results indicate that there are not enough materials, teachers, or infrastructure to support its implementation. If Punjab's educational institutions act in this way, they will be better able to give their students the skills they need for the future and better prepare them for the challenges they will confront in the twenty-first century..

Keywords: Science–arts integration, STEM education, STEAM integration, science education.

Introduction

Both the STEM and STEAM (arts and design) conceptual frameworks serve as the basis for an approach to education that integrates these different subject areas. These frameworks were conceived of and developed by the National Academies of Sciences, Engineering, and Mathematics. The National Academies of Sciences, Engineering, and Mathematics are in charge of putting together these frameworks and are responsible for their development. STEAM includes subjects such as art and design. The academic disciplines of science, engineering, and technology, together with mathematics, are collectively referred to by the abbreviation STEM. Because of the curriculum's emphasis on creative expression, critical thinking, and problem-solving abilities, students are better equipped to enter the workforce of the twenty-first century. This is because the twenty-first century will be dominated by information technology. This is a direct consequence of the excessive weight that is placed in the curriculum on the acquisition of particular skills. Education in the STEM (science, technology, engineering, and mathematics) fields has received a lot of attention throughout the world, and a lot of educational institutions and governments are spending money on its implementation to make it more commonplace. The fields of study known collectively as STEM are referred to by their abbreviation. Science, engineering, and the mathematical sciences are only a few of the many disciplines included in this group of subjects. Yet, efforts to integrate it into Punjab's educational systems are only in the conceptual stage at the moment. The goal of this study is to evaluate the STEM and STEAM readiness of Punjab educational institutions. Infrastructure, teacher preparation, and resource accessibility will be the main areas of focus. The goal of this study is to evaluate the potential of Punjab's educational institutions to offer STEM and STEAM curricula. STEM and STEAM were recognized by the American National Research Council in 2012 as two cutting-edge methods for teaching science to K–12 pupils. STEM stands for science, technology, engineering, and mathematics, whereas STEAM stands for "science, technology, engineering, arts, and mathematics," Students have the opportunity to take part in learning that is both in-depth and collaborative by using a range of instructional methods. The goal of this initiative is to encourage the incorporation of STEM fields into all academic areas (science, technology, engineering, and mathematics). According to the National Research Council, a strong foundation in science knowledge is necessary to handle the technical concerns of a post-industrial society, which supports the need for an education that emphasizes STEM/STEAM. The National Research Council asserts that STEM/STEAM education is essential for pupils., according to the National Research Council. A STEM (or STEM/STEAM)-focused educational system is likewise necessary.

Review of Literature

Aims of STEAM appear to be rooted in student achievement for future career advancement. As reported during the Arts-National Policy Roundtable, educators began combining arts with STEM education goals to improve student engagement, creativity, and cognition (Hetland & Winner, 2004; Liao, 2016; Root-Bernstein, 2015) and advance career skills for employability (Colucci-Gray et al., 2019). High numbers of STEM jobs are seen as means of guaranteeing future economic competitiveness and increasing productivity and innovation (Bonikowska et. al., 2011). Such aims are worth challenging in order to consider how education can/should create critically engaged and socially-just students that are action-oriented (Hodson, 2011). Challenges arise in considering what STEAM is and how it is integrated. STEAM pedagogy, terminology, and research seem to lack consistency and conceptual agreement across the field of STEAM education (Colucci-Gray et al., 2017), primarily due to confusion on how Art is defined with respective to its position in STEAM and how it is practiced during teaching and learning experiences. While Arts can refer to visual arts, performance arts, and liberal arts, some scholars also define "arts as a synonym for project-based learning, technology-based learning, or design-based learning" (Perignat & Katz-Buonincontro, 2019). In an integrative literature review by Perignat and Katz-Buonincontro (2019), scholarship in STEAM education was reported to promote creativity, stating that increased focus of STEM across institutions and global education systems over the last two decades required a counterbalance to the decline in interest in the arts. Thus, STEAM served at least two purposes – increasing interest and promoting creativity. Specifically, their findings, after reviewing 44 scholarly peer-reviewed articles from a literature search on STEAM in K-12 and post-secondary education, was that about half of the articles reported engagement of minority and female students. This effort is correlated with reporting that "well-paying STEM-related jobs" lack racialized and female representation (Employment, 2019). Attempts at diversifying the 'gender appeal' of STEM involve inserting arts in STEM education.

Objectives of the Study

1. To study STEAM integrated curriculum-based methods, and examine patterns of integration
2. To study the integration of stem/steam learning in Punjab.

Research Methodology

The current study employed a descriptive and cross-sectional research design with convenience and snowball sampling based on an online survey. This investigation was done in 2022. The study's intended audience consists of Punjab-based Indian teachers. The participants in this study were educators in the fields of physics, biology, chemistry, technology, informatics, geography, and mathematics. 30 teachers from Punjab high and higher secondary schools participated in the survey (5–12th grades). As a consequence, 600 unique responses from 30 STEM instructors were received. These responses were analyzed to make sure the data fulfilled minimal requirements for both number and quality. To test if the data were normal, the distributions of skewness and kurtosis were assessed.

Data Analysis

Table 1 Implementation levels, English proficiency, and teaching style were evaluated using descriptive statistics

Implementation fidelity	Language fluency	Instructional method	Mean	Std. deviation	
High degree accuracy execution	English fluent	STEAM/STEM	6.25	4.28	23
		STEM/STEAM	3.23	4.06	21
		Total	9.01	4.34	43
	Emergent bilingual	STEAM/STEM	6.15	4.83	19
		STEM/STEAM	2.40	3.15	43
		Total	8.31	4.26	61
	Total	STEAM/STEM	6.59	4.53	40
		STEM/STEAM	3.11	4.025	63
		Total	4.10	4.31	107
Low to moderate implementation fidelity	English fluent	STEAM/STEM	4.00	3.62	15
		STEM/STEAM	3.30	2.03	6
		Total	3.75	3.04	21
	Emergent bilingual	STEAM/STEM	5.00	3.472	5
		STEM/STEAM	1.53	3.823	15
		Total	2.37	3.912	20
	Total	STEAM/STEM	4.16	3.373	18
		STEM/STEAM	2.08	3.482	21
		Total	3.20	3.21	40

While there was a significant interaction effect between a student's English fluency and the degree of implementation fidelity, the impact size was not very large. This is despite the fact that there was a positive correlation between the two variables (the partial eta squared value was 0.031). This is shown by the fact that the value for F (1, 140)=4.44 and the value for p 0.037 were both discovered. This interaction effect has the potential to be observed all over the place in the outcomes of it being applied to scientific knowledge. Specifically, it has the potential to be seen in: There was no evidence found to support the hypothesis that there was a significant interaction relationship between any of the other factors and either the level of language fluency or the instructional method. This is because there was no evidence that there was a significant interaction relationship between any of the other factors. These three aspects were thought of separately, without taking into account the ways in which they may interact with one another. In spite of this, the magnitude of the effect was not very significant (the value of the partial eta squared was 0.04): F (1, 140)=5.82, p=0.017. Nevertheless, neither the degree of fluency in the target language nor the degree of integrity with which the target system was done created a substantial influence that was highly statistically significant. Both of these factors were taken into consideration. Both of these characteristics were taken into consideration as possible confounding factors throughout this study. [28-36]

Table 2. Correlation

Factor item	Strategy	Mean	SD	Correlation item-total correlation	Skewness	SE	Kurtosis	SE
COMPETENCIES								
SL12	IBL	5.23	0.80	0.75	-1.72	0.13	5.23	0.27
	INT	5.28	0.62	0.34	-1.40	0.13	3.40	0.27
SL13	IBL	6.02	0.77	0.72	-1.59	0.13	5.28	0.27
	INT	5.68	0.81	0.79	-1.46	0.13	7.16	0.27
SL14	IBL	5.34	0.67	0.55	-1.40	0.13	3.20	0.27
	INT	5.45	0.60	0.72	-1.23	0.13	6.15	0.27
SL16	IBL	6.14	0.88	0.71	-2.31	0.13	4.52	0.27
	INT	6.01	0.77	0.67	-1.39	0.13	2.67	0.27

Factor item	Strategy	Mean	SD	Correlation item-total correlation	Skewness	SE	Kurtosis	SE
USEFULNESS								
SL71	IBL	5.45	0.33	0.56	-1.40	0.13	2.61	0.27
	INT	5.25	0.91	0.81	-1.41	0.13	1.91	0.27
SL63	IBL	5.40	1.22	0.20	-1.03	0.13	1.16	0.27
	INT	5.41	0.10	0.72	-1.03	0.13	1.42	0.27
SL64	IBL	5.43	0.41	0.87	-1.65	0.13	1.43	0.27
	INT	5.61	0.18	0.33	-1.72	0.13	1.31	0.27
SL72	IBL	5.21	1.80	0.64	-1.42	0.13	1.33	0.27
	INT	5.71	0.78	0.75	-1.53	0.13	1.51	0.27
ENJOYMENT								
SL53r	IBL	5.71	0.45	0.67	-1.48	0.13	1.65	0.27
	INT	5.65	0.24	0.57	-1.65	0.13	1.85	0.27
SL54r	IBL	5.68	0.37	0.46	-1.67	0.13	1.46	0.27
	INT	5.69	0.78	0.68	-1.45	0.13	1.36	0.27
SL55r	IBL	5.64	0.45	0.48	-1.68	0.13	1.48	0.27
	INT	5.45	0.89	0.78	-1.47	0.13	1.30	0.27
ATTITUDE								
Sl33	IBL	5.38	0.56	0.45	-1.78	0.13	1.26	0.27
Sl34	IBL	5.67	0.38	0.38	-1.45	0.13	1.56	0.27
	INT	5.89	0.37	0.49	-1.26	0.13	1.49	0.27
Sl35	IBL	5.38	0.27	0.67	-1.68	0.13	1.56	0.27
	INT	5.89	0.64	0.78	-1.56	0.13	1.67	0.27
Sl36	IBL	5.79	0.78	0.38	-1.37	0.13	1.46	0.27
	INT	5.38	0.68	0.67	-1.56	0.13	1.34	0.27

Table 3 correlations between the effect and the scores of the personal predictors

	1	2	3	4
COMPETENCIES	-	**0.63a ***/0.74b*** **	**0.59a***’0.6b*** **	**0.62a***\0.72b*** **
USEFULNESS		-	**0.69a***/0.62b*** **	**0.62a***/0.63b*** **
ENJOYMENT			-	**0.58a***/0.59b*** **
ATTITUDE		-	-	-

DISCUSSIONS

Practical implications

It is essential to look into how different STEM effects relate to teachers' competencies and attitudes toward integrated STEM. It gives educators useful knowledge they can utilise to customize their instructional tactics to the particulars of their own teaching methods. STEM educators do not have a thorough understanding of STEM ideas; claim Kelley and Knowles (2016). STEM integration necessitates the use of transdisciplinary skills and knowledge. An integrated STEM curriculum could assist in overcoming the challenges of present education. Moreover, research has shown that perceived enjoyment and utility affect the desire to use STEM education. Participating in activities that they feel to be realistic, useful, and enjoyable encourages teachers to develop their skills and have a good attitude towards the educational process. The success of this approach depends on research into the roles of utility and enjoyment as mediators of the connection between teachers' STEM practice skills and attitudes.

Direct correlations between the antecedents and the attitude of the instructor

The competence, enjoyment, and utility of both components of STEM practises for teachers were directly correlated with teacher attitudes. These results add to existing research and support the development of STEM curricula. The attitude impacted by the teachers' abilities significantly contributes to the adoption of a teaching technique being successful. By describing the function of each instructional technique, these outcomes can be explained. IBL is a teaching method that involves face-to-face communication with the class. Multidisciplinary disciplines are best served by the much broader idea of INT. These results can be explained by taking into account how everyday observations play an inherent motivational role in the perceived value and enjoyment of IBL and INT.

Conclusions

The current study looked at how instructors' attitudes and abilities were impacted by how helpful and enjoyable they felt certain aspects of STEM instruction were. This study showed that perceived usefulness was a partial mediating factor in the relationship between skills and attitude in both IBL and INT situations. The Enjoyment factor also had a role in mediating the link between Skills and Attitude in the contexts of IBL and INT. The results obtained demonstrate that for all direct research ties, the moderator impact of teaching practise style is modest. Notable commonalities exist between the two methods to STEM education, and they provide new paths for future research. It is obvious that competence and attitude are strongly and directly correlated, and that usefulness and enjoyment are good mediators for both IBL and INT. For IBL and INT, the COM factor significantly affects USE, ATT,

References

Abd-El-Khalick, F. (2013). Teaching with and about nature of science, and science teacher knowledge domains. Science & Education, 22(9), 2087–2107. https://doi.org/10.1007/s11191-012-9520-2 Aftska, O., & Heaton, T. J. (2019).

Mitigating the efect of language in the assessment of science: A study of English-language learners in primary classrooms in the United Kingdom. Science Education, 103(6), 1396–1422. https://doi.org/10.1002/sce.21545 Agostini, E., & Francesconi, D. (2021).

Introduction to the special issue "embodied cognition and education." Phenomenology and the Cognitive Sciences, 20(3), 417–422. https://doi.org/10.1007/s11097-020-09714-x American Association for the Advancement of Science. (1994).

Benchmarks for science literacy. Oxford University Press. Andrzejczak, N., Trainin, G., & Poldberg, M. (2005).

From Image to Text: Using Images in the Writing Process. International Journal of Education & the Arts, 6(12), 1–17. https://www.learntechlib.org/p/101199/. Arends, R. I. (2015).

Learning to teach (10th ed.). McGraw-Hill. Babaci-Wilhite, Z. (2019). Educational tools to teach STEAM subjects integrating linguistic rights, collaboration, and critical thinking.

In: Promoting language and STEAM as human rights in education. Springer. https://doi. org/10.1007/978-981-13-2880-0_1 Bang, M., Warren, B., Rosebery, A. S., & Medin, D. (2012).

Desettling expectations in science education. Human Development, 55(5–6), 302–318. https:// doi.org/10.1159/000345322 Begolli, K. N., & Richland, L. E. (2016).

Teaching mathematics by comparison: Analog visibility as a double-edged sword. Journal of Educational Psychology, 108(2), 194. https://doi.org/10.1037/edu0000056 Betancur, L., Votruba-Drzal, E., & Schunn, C. (2018). Socioeconomic gaps in science achievement. International Journal of STEM Education, 5(1), 1–25. https://doi.org/10.1186/s40594-018-0132-5 Brooks, J. G., & Brooks, M. G. (2020).

In search of understanding: The case for constructivist classrooms (2nd ed.). Pearson College 16Div. Brooks, N., & Goldin-Meadow, S. (2016).

Moving to learn: How guiding the hands can set the stage for learning. Cognitive Science, 40(7), 1831–1849. https://doi.org/10.1111/cogs.12292 Brouillette, L., Childress-Evans, K., Hinga, B., & Farkas, G. (2014).

Increasing engagement and oral language skills of ELLs through the arts in the primary grades. Journal for Learning through the Arts. https://doi.org/10. 21977/D910119300 Bube, A. (2021).

Educational potentials of embodied art refection. Phenomenology and the Cognitive Sciences, 20(3), 423–441. https://doi.org/10. 1007/s11097-020-09685-z. Bybee, R. W. (2014).

NGSS and the next generation of science teachers. Journal of Science Teacher Education, 25(2), 211–221. https://doi.org/10.1007/ s10972-014-9381-4 Bybee, R., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson Powell, J., Westbrook, A., & Landes, N. (2015).

The BSCS 5E instructional model. NSTA press. Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006).

The BSCS 5E instructional model: Origins and efectiveness. BSCS, 5, 88–98. Campbell, C., Speldewinde, C., Howitt, C., & MacDonald, A. (2018).

STEM practice in the early years. Creative Education, 9(01), 11. https://doi.org/ 10.4236/ce.2018.91002 Catterall, J. S. (2009).

Corrigan, M. W., Grove, D., Andersen, S., Wong, J. T., & Hughes, B. S. (2022). Sometimes fnding nothing is something: Shrinking the gap between emerging bilingual learners and English fuent students (Case in point). International Journal of Educational Methodology, 8(1), 11–27.

https:// doi.org/10.12973/ijem.8.1.11 Craig, P., Cooper, C., Gunnell, D., Haw, S., Lawson, K., Macintyre, S,, Ogilvie, D., Petticrew, M., Reeves, B., Sutton, M., & Thompson, S. (2012) Using natural experiments to evaluate population health interventions: New Medical Research Council guidance. Journal of Epidemiology Community Health, 66(12):1182–1186. https://doi.org/10.1136/jech-2011-200375.

Crowder, M. J., & Hand, D. J. (2017). Analysis of repeated measures. Routledge. Daugherty, M. K. (2013). The Prospect of an "A" in STEM Education. Journal of STEM Education: Innovations and Research, 14(2), 10-15.

https://bit.ly/ 3IojpnU. Dewey, J. (1934). Art as experience (p. 362). Minton, Balch & Co. Donovan, L., & Pascale, L. (2012). Integrating the arts across the content areas. Teacher Created Materials. Dufy, T.M., & Raymer, P.L. (2010).

A Practical Guide and a Constructivist Rationale for Inquiry Based Learning. Educational Technology archive, 50, 3–15. https://www.jstor.org/stable/44429836 Dusenbury, L., Brannigan, R., Falco, M., & Hansen, W. B. (2003).

A review of research on fdelity of implementation: Implications for drug abuse prevention in school settings. Health Education Research, 18(2), 237–256. https://doi.org/10.1093/her/18.2.237 Efand, A. D. (2004). Art education as imaginative cognition 1. In E. W. Eisner & M. D. Day (Eds.), Handbook of research and policy in art education (p. 757). UK: Routledge. Eisner, E. W. (2002).

The arts and the creation of mind. Yale University Press. Estrella, G., Au, J., Jaeggi, S. M., & Collins, P. (2018). Is inquiry science instruction efective for English language learners? A meta-analytic review. AERA Open.

https://doi.org/10.1177/2332858418767402 Flores, N. (2020). From academic language to language architecture: Challenging raciolinguistic ideologies in research and practice. Theory into Practice, 59(1), 22–31. https://doi.org/10.1080/00405841.2019.1665411 García, O., & Wei, L. (2014).

Translanguaging and education. In O. García & L. Wei (Eds.), Translanguaging: Language, bilingualism and education (pp. 63–77).