Shodh Sari-An International Multidisciplinary Journal

2025, Vol. 04, Issue 03, 129-143
ISSN: 2959-1376
DOI: https://doi.org/10.59231/SARI7842

Interdisciplinary Synergy Bridging Gap between STEM and Humanities for Sustainable Development

Parween, Shagufta [1], Jameer MD, Roshan [2] and Kumuja, V Temuzion [3]

[1]Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology (A),
Orcid ID: 0009-0002-3298-0843

[2]Head & Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology (A)
ORCID: 0009-0002-5221-4137

[3]Assistant Professor, Department of English, Chaitanya Bharathi Institute of Technology (A)
ORCID: 0009-0009-8687-1504

Abstract

The discourse about sustainable development calls for a comprehensive approach transcending disciplinary bounds. Indeed, while the STEM (Science-Technology-Engineering-Mathematics) set in the technical base, namely tools and innovations to tackle global challenges, the humanities arm us with the sociology/ethics orientation and provide a coherent framework for understanding how societal/individual behaviour interacts in decision-making. The practice paper explores the theoretical tenets of interdisciplinary synergy, stressing the urgency of breaking down the divide between these two fields to allow the sustainable growth agenda to make real shifts and impacts. By synthesising the analytical acumen of STEM with the context- and interpretational strengths of the humanities, it is argued in this paper that we could have a sound and inclusive frame to address ill-structured issues, such as climate change, resource depletion, and societal inequity. This paper outlines the historical and structural divides between STEM and the humanities, illustrating how these have constrained their collaborative pursuits; it then provides the case studies of successful interdisciplinary programs tailored to merging scientific innovation with a perspective geared to the humanities in some capacity for the purposes of sustainability. In these cases, effective interdisciplinary collaboration was shown, especially in areas such as renewable energy, urban planning, and environmental policy. It also presents the issue of education as a supporter of

@2025 International Council for Education Research and Training 2025, Vol. 04, Issue 03, 129-143
ISSN: 2959-1376 DOI: https://doi.org/10.59231/SARI7842

interdisciplinary thinking and suggestions for curriculum and teaching methods which promote interactions between technical and humanistic fields. At the end of the work, the research maintains that a common language and mutual respect be created between the STEM and humanities sides. Interdisciplinary synergy will, therefore, present excellent opportunities for sustainable solutions to the current societal conditions, thus safeguarding future generations on fleeing.

Keywords: Interdisciplinary Synergy, STEM-Humanities Integration, Sustainable Development, Cross-Disciplinary Collaboration, Holistic Problem-Solving

Introduction:

The interdisciplinary synergy that bridges the divide between the STEM and human-arts/humanities is an emerging educational approach for sustainable development. This coupling recognizes the interactiveness of several fields and emphasizes the importance of giving students a comprehensive set of skills that will allow them to tackle societal challenges of considerable magnitude. This interdisciplinary framework enables one to combine technology-based know-how with a humanistic view of society, which raises creativity, balanced thinking, attachment-theory-based perspectives, empathy, etc. These skills will help solve some of today's pressing global big-picture problems, such as climate change, social justice, and technological ethics.[1][2][3].

Recent initiatives such as STEAM exemplify a growing awareness of the importance of incorporating aspects of the arts and humanities in traditional STEM education. Such a shift is a direct response to historical calls for a curriculum reflective of the realities underpinning modern interdisciplinary practice and accelerating demand for innovators capable of both embracing technological discoveries and engaging human experience.[1][2][4]. Sports, A science behind design(activity)-based-learning-kids would be their underlying theme in STEM education. Such educational models propagate integrated STEM frameworks along with design thinking methodologies that further showcase interactive and experience-based learning modalities which can bring about solutions commensurate with the 2030 agenda adopted for sustainable development goals by the United Nations.[5][6].

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

However, the integration of these disciplines is beset with a number of hurdles. Changes are resisted in the academic setting, systemic obstacles exist for equality and access, and the inviolable walls of traditional disciplines so often block any construction of comprehensive interdisciplinary programs.[7]. Even the complexities of language and the digital media through which knowledge is disseminated is shown to affect the metacognitive competencies of the students [8]. There have also been, and there likely will continue to be, debates on how effective and rigorous upping-bodied integration between arts and humanities and STEM is, certainly one that will necessitate a change in culture and mindset as far as educational practice and assessment are concerned to show clearly the benefits.[9][10]. The STEM and humanities union provides an excellent and practical target for interdisciplinary collaboration in natural resource conservation. It is said to offer holistic schooling using resourceful viewpoints to nurture an emerging group of learners who engage in responsible innovation and promote fair solutions for the myriad of problems encountered by people across the globe.[11][12][13].

The stem-hum-collaboration of this ever-fascinating journey was traced back from antiquity civilization interactive streams when there was often an eerie confusion with which to draw between the scholarly assignations of these particular context. The early masters, like Aristotle and Leonardo da Vinci, activated a seamless coalescence of empirical study with that of this unique form of artistic expression, setting down the bedrock upon which modern interdisciplinary studies would be constructed[1]. This process and mingling did not stop at the intersection of another stream of cultural-humanistic thought-Renaissance, which is characterized by an immense growth of humanistic thought. It draws attention to the innovativeness of merging scientific knowledge with a humane and deeper understanding of human experiences[1][14].

As the nature of education shifted historically, concern for the intercession grew swiftly. By the close of the twentieth century, teachers started recognizing the need to prepare themselves concerning complex social problems that required skills both from STEM and humanists[2]. For prominent historical figures like Ada Lovelace and Albert Einstein, the interplay of arts and sciences bore significant consequences for technology and culture[1].

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

Fusion in present-day teaching is perceived as paramount toward innovation and creative thinking. Thus, students tackle ever-more-complex problems, an interdisciplinary project is a blend of various insights with the view to create an iterative learning experience[2][15]. In their drawing of a backdrop of historical approaches toward integration, the teachers stress the need for an interdisciplinary curriculum not only to enhance educational performance but also to prepare students for manifold interdisciplinary career openings[1][2].

Finally, by placing the point of view in the historical context of the integration of STEM and humanities where an interaction could yield an insight as to determining the challenges confronting development today, the two of them can scholastically stand together[2][4]. The historical contributions of the early scholars speak to the ISP's guide for appreciating an overarching approach whereby these disciplines enhance their understanding and apply such an understanding to curing complex scientific problems.

Key Concepts

Holistic Education

A comprehensive education incorporates STEM and humanities to provide students with enough exposure to diverse competencies to tackle cross-disciplinary challenges. It stresses on combining the essence of technical knowledge with a humanistic paradigm that propagates empathy and imagination in solving messy problems[1] Interdisciplinary learning programs like STEAM (Science, Technology, Engineering, Arts, and Mathematics) urge students to examine problems through multidimensional lenses, broadening career opportunities within academic arenas, therefore, increasing the amount of value they create for society.[1]

Integrated STEM Framework

The integrated STEM framework envisages putting into practice the basic unique traits of STEM education, with an emphasis on real-world challenge, engineering, and context and content integration. This framework addresses the need for engaging learners in real-life problems that require inter-disciplinary knowledge and skills.[3] The seven features articulated in this framework provide a compass for practitioners and curriculum program developers to understand better integrated STEM practices.[3]

Interdisciplinary Approach

Interdisciplinary teaching fosters critical thinking, cooperation, and the practically

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

individualized transferring of knowledge. By intertwining multiple disciplines, students can resolve complex issues regarding contemporary problems that overlap various fields in sciences[16][5] This approach advocates project-based learning and contextual integration, enabling students to draw connections between subjects and apply their learning to real-world applications.[11]

Design Thinking Methodology

Design thinking is an iterative process focused on the user, allowing creativity and problem-solving while developing solutions. This process fits well with the 17 UN Sustainable Development Goals (SDGs), as it will need a multidisciplinary perspective to face complex problems, like clean drinking water or sustainable energy.[5] Through evaluation and solution making, this design thinking process allows the students to identify local charges and come up with operational solutions toward promoting innovative mentalities and citizenship.[5]

Collaboration and Continuous Adaptation

The successful approach of interdisciplinary education becomes a feat when teachers, students, and industry professionals collaborate. Organized interdisciplinary teams present a collaborative space for the communication of ideas and knowledge-based solutions applicable under different sets of perspectives, while at the same time promoting collective value in diversity.[12] The basic agenda of interdisciplinary education should be that its design, planning, and restructuring are dynamic processes; a constant evaluation with reconsiderations should always accompany interdisciplinary programs, suiting an ever-evolving education situation and trends with inputs sought from the industry and other sources for providing experiences that add value to learning.[12]

Areas of Intersection

Integrated STEM Education

Integrating science, technology, engineering, and math (STEM) is critical for application in education and enhancement of student engagement. Research has shown that teachers who identify common practices within STEM can credibly substantiate unique demonstration examples across the interconnected field. This approach affords students the capacity to comprehend the unique aspects of each of these areas while simultaneously guiding them in making informed decisions about their subsequent career paths in STEM[14]. The integrated STEM education framework revolves around simultaneous teaching of

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

content and practices, correctly attuned in the realization that both represent a parallel character to rich learning engagement.

Convergence of Disciplines

Convergence refers to the intentionally integrated approaches of knowledge from different disciplines toward researching, teaching, and transferring knowledge in GENERA [17]. Examples would include the initiatives in the delta regions around Rotterdam and Delft, which have shown how medical sciences, technical domains, and social sciences can collaborate and converge in order to address some of the most pressing global issues, such as climate change and sustainability. The approach of living laboratories is also set here within a convergence sharing experience that encourages cooperation from the business and the public sectors to build a resilient knowledge ecosystem[17] [18] [19]. This change in focus results in a constructive dialogue on complex issues, marking the way forward for viable solutions in society [20].

Global Sustainability Goals

The linkage between STEM and global sustainability objectives, in particular, the United Nations Sustainable Development Goals (SDGs), reveals the significance of transdisciplinary collaboration. Several case studies—from Costa Rica's complex agroforestry systems to Sweden's circular economy model—indicate how localized efforts can contribute to these larger aims. These examples showcase not just measurable outcomes, for example, significant reductions in material consumption with a metamorphosis of climate impact outputs, but also provide strategic insights into practicing the studied effect[13]. Integrating sustainability with STEM education prepares a generation of learners capable of solving global problems [21].

Role of Technology in Sustainability

Sustainable technology is thus extremely important given reduction of the impacts on the environment with a possibility for them to address the sustainability problem [22]. Different sectors of industry have started to take note and employ practices crafted with a focus of lowering emissions and shrinking their carbon footprints. Thus, teaching about sustainability through conventional definitions with VR and carbon footprints tend to disturb any meaningful engagement in market actors towards activities of environmental stewardship[18]. Shifting this paradigm enables the development of not just new

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

technologies but a guiding ethical framework for their application across different sectors.

Addressing Inequities through Environmental Stewardship

Environmental stewardship being linked with social equity is an important consideration in the areas of STEM. Recognizing the disproportionate impacts of certain members of society against specific populations, for instance in urban locations wherein residents are subjected to high exposure of air pollution, through this additional mission would call for targeted remedies. Such STEM education that embraces these themes emboldens students to approve more inclusive approaches catering to sustaining the welfare of the community through the address against environmental challenges[23]. By creating awareness of these inequities, they can empower the next crop of leaders to advocate for equitable and sustainable practices that have benefits for each sector of society [24].

Challenges and Barriers

Although STEM and the humanities constitute a seamless approach in promoting sustainability, it is still faced with challenges and hurdles to be bridged [25]. Understanding these impediments is critical in developing any effective form of interdisciplinary collaboration and create sustainable pathways [26].

Educational and Institutional Limitations

Some universities and funding sponsors still adhere to traditional disciplinary boundaries, thereby making interdisciplinary research and teaching extremely difficult[7]. Such discontinuity often results in lack of encouragement and consideration for methodologies and epistemologies in different subjects, as different fields, such as Humanities and Sciences, may employ varying methods of inquiry. Such differences may bring about misunderstandings or conflicts, and a commitment to mutual respect and ongoing dialogue may only resolve these problems. [7].

Systemic Barriers

The issues of inequity and access in STEM education involve substantive structural discrimination faced by marginalized sections, who often face economic adversity, lack of resources, and absence from such professions[8]. Differences in geographic location, socio-economic status, and cultural bias prolong the effort to render quality STEM programs accessible, further complicating the integration of diverse perspectives from the humanities[8].

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

Resistance to Change

The other significant hindrance is resistance to change-coming from those within academia. Some educators and researchers may think that the infusion of humanities into the STEM rendered the scientific training too shallow, or endangered the depth of humanistic inquiry. In overcoming such perceptions, credible benefits of interdisciplinary work must be demonstrated, e.g., improved patient outcomes resulting from narrative medicine in medical school education, which trains doctors to better comprehend the story of their patients[7][9].

Cultural and Political Factors

Thus, the cultural context in which education systems subsist can nip in the bud inter-disciplinary collaboration. For instance, the disenfranchisement of minority literatures and languages can genuinely throttle knowledge production and critical semiotic inquiry[10]. Moreover, the rise of authoritarian governance in various regions can threaten intellectual freedom and hinder collaborative efforts in research and education[10].

Need for Practical Assessment Tools

There is a great need for the development of concrete, practical assessment tools, and guidelines covering interdisciplinary education [27]. Today, whereas STEM education is on the increase, many teachers have never been formally trained on assessing student learning across disciplines.

Frameworks and Models

Conceptual Framework for Integrated STEM Education

The combination of STEM education and the liberal arts needs a sound conceptual framework articulated towards secondary school-based and higher education curricula and instructional practices [28]. It is intended to guide teachers and learners through integrated STEM education, making links across various STEM practices, and great for learners' experience.[14] The engineering design approach underpins the curriculum framework and serves as an optimal way to integrate the STEM domains. By using engineering design as a starting point, teachers can create a sound way of teaching problem-solving that cuts across all STEM fields, with an augment in the subject integration and teamwork among the students.[14][13].

Interdisciplinary Approaches in Higher Education

Interdisciplinary education is characterized as increasingly essential in providing solutions to multifaceted contemporary global challenges [29]. As such, it becomes much more

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

appealing to support initiatives like that of the Interdisciplinary Design-Based Curriculum, otherwise abbreviated as interdbbc-a collective initiative involving educators and researchers in the domain of developing interdisciplinary education practices. Participants of the initiatives believe that student involvement remains critical, given that students in both design-based programs seldom attend lectures; hence, the techniques of student engagement need be revitalized with alacrity.[11].

Case Studies and Practical Applications

Also, another challenge is in validating the quality and outputs of interdisciplinary education, craving the wholesome establishment of sound assessment and corresponding empirical inquiry that can govern the best practices[13]. Moreover, initiatives like Costa Rica's agroforestry systems and Sweden's circular economy model showcase how localized efforts align with broader sustainability goals, offering measurable outcomes and strategic insights for scaling successes in diverse contexts[13].

Collaborative Curriculum Design

To create an interdisciplinary curriculum requires that the educator skillfully construct lessons that effectively leverage multiple disciplines [30] [31]. Such an approach improves student learning outcomes while giving them critical problem-solving skills and a comprehensive insight into interconnected subject areas. Collaborative efforts among teachers become extremely imperative as this creates a climate for interdisciplinary thinking[30]. With mobile devices and project management tools that allow real-time collaboration, teachers can now take that experience even further by communicating and innovating together through shared observations[30].

Moving Forward with Interdisciplinary Education

To facilitate interdisciplinary learning, it is imperative to nurture a culture of continual ripening, wherein challenges such as mental constraints, preparatory needs, and measuring interdisciplinary competencies need strong focus. Assessment methods, faculty training, and scholarly research, characterized with understanding about the outcome of the inter-disciplinary programs, will be formed to boost further efforts in this agenda. Educational establishments will therefore render students better equipped to face a future that increasingly values knowledge integration across domains.[11]

Future Directions

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

Interdisciplinary Collaboration

Collaborative cross-disciplinary projects linking STEM (science, technology, engineering, mathematics) to the humanities represent a burgeoning future of education and innovation. Their aim is to promote the treatment of the intricate global challenges requiring collaborative environments with diverse perspectives. This necessity of collaboration across disciplines is evidenced by the FutureEd movement, wherein inferences are made that other collaborative fields and spaces should be sought out so as to formulate new patterns of learning responsive to present necessities and future ambitions.[4]. The integration of the following strategies will be the most appropriate in achieving this: establishing common ground amongst fields of learning, physical spaces for collaboration, and the use of technology for communication and coordination within the project. [12].

Focus on Sustainable Development

The United Nations Sustainable Development Goals framework represents a cornerstone for interdisciplinary initiatives. By connecting various educational projects to the relevant SDGs, students and instructors can productively combine their efforts toward pertinent problems such as water management and renewable energy production, thus furthering active learning and transdisciplinary collaboration[6]. Such foci serve to not only enhance educational outcomes but also mobilize the future leadership toward the effective tackling of local and global sustainability issues through stringent collaboration and team-building.[32] [33]. Incorporating interdisciplinary methods in curricula design and pedagogical implementation and integrated STEM principles fosters a holistic and innovative approach to sustainable learning [34].

Cultural Paradigm Shifts

Together, these shifts in culture among the younger generations work their magic in reshaping expectations concerning accountability regarding sustainability and the environment. The clear demand for sustainable practices and renewable energy solutions is becoming ever more pronounced by the generalized appreciation of the broader society concerning environmental impacts[22]. With these values now settling into educational environments, it has become more necessary to engage in interdisciplinary collaboration in the various response modes to the critical set of challenges presented by the world interconnectedness.[35]. Reconceptualizing

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

the sciences and humanities through an integral approach not only bridges disciplinary divides but also advances the state of the art in STEM integration, fostering a more cohesive and innovative framework for sustainable education and research [36].

References:

1. Al Hamad, N. M., Adewusi, O. E., Unachukwu, C. C., Osawaru, B., & Chisom, O. N. (2024). A review on the innovative approaches to STEM education. *International Journal of Science and Research Archive*, *11*(1), 244–252. https://doi.org/10.30574/ijsra.2024.11.1.0026
2. Alvesson, M., & Sköldberg, K. (2023, December 19). *Viewpoint: We need a blueprint for integrating social sciences and humanities in the EU. Science business*.
3. Aunzo, Jr., R. T. (2025). Advancing sustainable development goals with educational technology: Supporting STEM education and fostering innovation through educational technology. In *Advancing sustainable development goals with educational technology* (pp. 65–98). IGI Global Scientific Publishing.
4. Bear, A., & Skorton, D. (Eds.). (2018). *The integration of the humanities and arts with sciences, engineering, and medicine in higher education: Branches from the same tree*. The National Academies Press.
5. Borda, E., Schumacher, E., Hanley, D., Geary, E., Warren, S., Ipsen, C., & Stredicke, L. (2020). Initial implementation of active learning strategies in large, lecture STEM courses: Lessons learned from a multi-institutional, interdisciplinary STEM faculty development program. *International Journal of STEM Education*, *7*(1), 1–18. https://doi.org/10.1186/s40594-020-0203-2
6. Brennan, R. IGE: Stakeholder-driven sustainable development experiences for enhancing stem graduate education. National Science Foundation. https://sites.psu.edu/rachelbrennan/ige-stakeholder-driven-sustainable-development-experiences-for-enhancing-stem-graduate-education/
7. Bybee, R. W. (2013). *The case for STEM education: Challenges and opportunities*. NSTA Press.

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

8. Case, B., & VanderWeele, T. J. (2024). Integrating the humanities and the social sciences: Six approaches and case studies. *Humanities and Social Sciences Communications*, *11*(1), 231. https://doi.org/10.1057/s41599-024-02684-4
9. Chatterjee, S. (2025). Integrating science, technology and humanities for sustainable development. In A. Ghosh (Ed.), *Knowledge, society and sustainability: Multidisciplinary approaches* (pp. 132–139).
10. Chow, A. L. Y., & Seng, S. L. (2024, June 23). *Reimagining interdisciplinary learning: Challenges and solutions. Interdisciplinary dialogues blog*.
11. Cohen, S. (2025). Technology and environmental sustainability, *Columbia SPS*. https://sps.columbia.edu/news/technology-and-environmental-sustainability
12. Cordaro, J. A., Murphy, C., & Redman, E. (2025). Bridging STEM education and sustainability: Insights from Pennsylvania educators. *Education Sciences*, *15*(3), 282. https://doi.org/10.3390/educsci15030282
13. Crone, E., & Georgievska-van de Laar, M. (2024). Viewpoint: We need a blueprint for integrating social sciences and humanities into EU research, Science Business. https://sciencebusiness.net/viewpoint/horizon-europe/viewpoint-we-need-blueprint-integrating-social-sciences-and-humanities-eu
14. De Albuquerque, C. V., Cordeiro, A. M. R., Alcoforado, J. L. M., & Carvalho, J. A. R. (2024, December). The sustainable development goals, master plans and the school curriculum: An interdisciplinary scoping review. In *Frontiers in Education*, *9*. Frontiers Media SA. https://doi.org/10.3389/feduc.2024.1452475
15. D'Ignazio, C., & Klein, L. F. (2020). Data feminism. In *The MIT Press eBooks*. https://doi.org/10.7551/mitpress/11805.001.0001
16. Ferguson, R. (2025, February 7). Reconciling the Humanities and STEM: Methods, Models, and impact. *nationalhumanitiescenter.org*. National Humanities Center. https://nationalhumanitiescenter.org/education-programs/institutes/reconciling-the-humanities-and-stem-methods-models-and-impact/

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

17. Gao, X., Li, P., Shen, J., & Sun, H. (2020). Reviewing assessment of student learning in interdisciplinary STEM education. *International Journal of STEM Education*, *7*(1), 1–14. https://doi.org/10.1186/s40594-020-00225-4
18. Hirsch, A., Hirsch, A., & Hirsch, A. (2025, January 10). Combining STEM and Humanities: Broaden skills and enrich learning. Center for Innovative Teaching and Learning -. https:. http://citl.news.niu.edu/2025/01/10/combining-stem-and-humanities-broaden-skills-and-enrich-learning/
19. Howes, A., Kaneva, D., Swanson, D., & Williams, J. (2013). Re-envisioning STEM education: Curriculum, assessment and integrated, interdisciplinary studies. *A report for the Royal Society's Vision for Science and Mathematics Education*. London, UK. https://royalsociety.org/~/media/education/policy/vision/reports/ev-2-vision-research-report-20140624.pdf
20. Huntley, S. (2020, May 15). Introducing HASTAC: From STEM to STEAM— Government relations. *Government Relations*. https://governmentrelations.duke.edu/2014/02/26/introducing-hastac-from-stem-to-steam/
21. Jacobs, M. A., Mancuso, K. C., Shahbazi, Z., Lehnes, A. E., & Scotti, A. (2016, June). Hands-on STEM lesson plans developed through engineering faculty and STEM teacher collaboration (evaluation). In ASEE Annual Conference y Exposition. https://doi.org/10.18260/p.25446
22. Johnson, C. C., & Czerniak, C. M. (2023). Interdisciplinary approaches and integrated STEM in science teaching. In *Handbook of research on science education* (pp. 559–585). Routledge. https://doi.org/10.4324/9780367855758-22
23. Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education*, *3*(1). https://doi.org/10.1186/s40594-016-0046-z
24. Kennedy, T. J., & Cherry, A. R. (2023). Sustainable development goals and science and technology education. In B. Akpan, B. Cavas, T. Kennedy (Eds.), *Contemporary issues in science and*

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842

technology education (pp. 131–149). Springer Nature. https://doi.org/10.1007/978-3-031-24259-5_10

25. Little, G. (2017). Connecting environmental humanities: Developing interdisciplinary collaborative method. *Humanities*, *6*(4), 91. https://doi.org/10.3390/h6040091
26. Malik, S. C. (2022). *Reconceptualizing the sciences and the humanities: An integral approach. DK Printworld (P) Ltd*.
27. Mandal, S. (2024). Roadmap for humanities and social sciences in STEM higher education: An introduction. In S. Mandal (Ed.), *Roadmap for humanities and social sciences in STEM higher education* (pp. 3–21). Springer Nature. https://doi.org/10.1007/978-981-97-4275-2_1
28. Marcone, G. (2022). Humanities and social sciences in relation to sustainable development goals and STEM education. *Sustainability*, *14*(6), 3279. https://doi.org/10.3390/su14063279
29. Moore, T. J., & Smith, K. A. (2014). Advancing the state of the art of STEM integration. *Journal of STEM Education: Innovations and Research*, *15*(1), 5. https://karlsmithmn.org/wp-content/uploads/2017/08/Moore-Smith-JSTEMEd-GuestEditorialF.pdf
30. Omotoyosi, F. O., Abidemi, L. A., Akinsola, O., & Bilikis, L. A. (2025). Evaluating the effectiveness of policy initiatives aimed at closing the stem education achievement gap. *International Journal of Scientific and Engineering Research*, *14*(02), 1129–1136. https://doi.org/10.30574/ijsra.2025.14.2.0496
31. Parween, N. D. S., Kumuja, N. V. T., Jameer, N. R. MD, & Duvvuri, N. A. (2024). Navigating the complexities of domain specific English: Analyzing the influence of digital media on the metacognitive and linguistic competence of management students. *Evolutionary Studies in Imaginative Culture*, 1044–1052. https://doi.org/10.70082/esiculture.vi.1260
32. Scholkmann, A., Stegeager, N., & Miller, R. K. (2023). Integrating the integration: The role and challenges of problem-based learning in bringing together social science and humanities (SSH) and science, technology, engineering and

@2025 International Council for Education Research and Training
ISSN: 2959-1376
2025, Vol. 04, Issue 03, 129-143
DOI: https://doi.org/10.59231/SARI7842
Received on March 01, 2025
Accepted on May 20, 2025
Published on July 01, 2025

mathematics (STEM). *Journal of Problem Based Learning in Higher Education*, *11*(1), 98–123. https://doi.org/10.54337/ojs.jpblhe.v11i1.7371

33. Shee Weng, L. (January 12, 2025). Available at SSRN. From theory to impact: Interdisciplinary strategies, case studies, and emerging trends in global sustainability. https://ssrn.com/abstract=5134043 or http://dx.doi.org/10.2139/ssrn.5134043
34. Williams, A. (2024). Sustainable technology: Examples, benefits and challenges. *Forbes*. https://www.forbes.com/sites/technology/article/sustainable-technology/
35. Yanez, G. A., Thumlert, K., De Castell, S., & Jenson, J. (2019). Pathways to sustainable futures: A "production pedagogy" model for STEM education. *Futures*, *108*, 27–36. https://doi.org/10.1016/j.futures.2019.02.021