ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

21st-Century Skill Development in Transdisciplinary Classrooms: A Qualitative Exploration of Pedagogical Practices and Learner Experiences

Mukesh Haldar[1]

[1]Research Scholar, Department of Education,
University of Kalyani, Nadia, West Bengal

Publication Date: 2026/04/03

Abstract: Education in the twenty-first century is increasingly shaped by rapid technological advancements, global connectivity, and complex societal and environmental challenges. In this changing environment, learners need important skills, such as critical thinking, creativity, teamwork, communication, and the ability to solve problems, to effectively engage with new information. In contrast, traditional subject-centered teaching strategies often teach information in isolation and emphasize memorization rather than comprehension and practical use. Against these drawbacks, transdisciplinary learning became an integrated educational method that bridges knowledge between different disciplines and aligns classroom teaching with the real world.

The current study seeks to investigate the notion of transdisciplinary learning, the pedagogical strategies implemented in transdisciplinary education that foster the twenty-first century skill development, learners' perspectives and experiences in the practice of skill development in transdisciplinary learning contexts, and the facilitators and barriers for teachers and students when implementing transdisciplinary teaching.

This research has a qualitative descriptive methodology and is primarily derived from secondary data sources, that is, research papers, academic journals, peer-reviewed literature, and educational policy papers regarding transdisciplinary education and skill-based learning. After thematic analysis examining thematic content from this literature, the study focuses on key concepts of transdisciplinary learning, pedagogical methods in integrated classrooms, learner perspectives, experiential learning, and practical issues encountered on implementation. It focuses attention on the teaching approaches including inquiry learning, project learning, collaborative research, and real-world problem-solving that add to capacity building.

The results indicate that transdisciplinary learning opportunities are beneficial places for students to apply concepts across subjects and for students to cultivate thinking and learning on several levels. Students claim higher levels of engagement, confidence, and creativity in working on cross-disciplinary projects and in authentic problem-solving activities, they state. But obstacles including inflexible curricula, minimal cross-disciplinary teacher training, and assessment limitations can act as a barrier to implementation. Accordingly, this research emphasizes the importance of enabling institution-based policies, professional development for teachers, and flexible curriculum frameworks in integrating transdisciplinary practices and development of skill development in a blended system of schooling in modern education.

Keywords*: Transdisciplinary Learning, Skill Development, Integrated Pedagogy, 21st-Century Skills.*

How to Cite: Mukesh Haldar (2026) 21st-Century Skill Development in Transdisciplinary Classrooms: A Qualitative Exploration of Pedagogical Practices and Learner Experiences. *International Journal of Innovative Science and Research Technology*, 11(4), 6-12. https://doi.org/10.38124/ijisrt/26apr099

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

I. INTRODUCTION

The nature of education in the 21st century has undergone significant change as a result of rapid technological development, increased global connectivity, and a more complex society. As a result of these changes, contemporary learners need to adopt critical thinking, creative, collaborative, communication, and problem-solving skills to be successful in an ever-changing, interdependent world. Critical thinking, creative, collaborative, communication, and problem-solving skills have become necessary for participation in today's society. Unfortunately, many contemporary educational institutions continue to use traditional subject-based instructional methods that severely limit the development of students' ability to apply their skills holistically because traditional subject-based instruction isolates knowledge and emphasizes rote memorization of knowledge rather than understanding and applying it in context.

In response to all of the limitations mentioned above, transdisciplinary education has developed as a new, and very integrated form of education. Transdisciplinary education involves the integration of ideas, methods, and skills from different academic disciplines to explore and solve real-world problems. This approach moves beyond traditional subject boundaries and promotes meaningful connections between theoretical knowledge and its practical application.

The potential Advantages of transdisciplinary education are vast, as they include developing active engagement, inquiry, collaboration, and reflective thinking among learners.

The National Education Policy (NEP) 2020, educational reform efforts have placed greater emphasis on the use of practical, skill-based and multidisciplinary teaching methods. The focus of educational policy has shifted toward experiential learning, and toward the holistic development of learners as opposed to teaching through examinations.

This study attempts to explore the pedagogical practices and lived experiences within transdisciplinary classrooms, processes that can influence the development of 21st century skills. Schools are now being encouraged to develop learning experiences that enhance creativity, critical thinking, collaboration, and problem-solving abilities in students. Through observations of participants' experiences and classroom realities, this study seeks to develop a deeper understanding of how transdisciplinary teaching develops essential skills.

II. LITERATURE REVIEW

- Jean Piaget (1972) introduced the concept of trans disciplinarity and explained that knowledge should go beyond subject boundaries. He believed that learning becomes meaningful when students connect ideas from different disciplines.
- Basarab Nicolescu (2002) expanded the idea of transdisciplinary education. He emphasized unity of knowledge and stated that complex real-world problems require integrated understanding across subjects.
- Veronica Boix Mansilla (2010) highlighted that interdisciplinary and transdisciplinary learning promote deeper understanding and critical thinking when students apply knowledge in authentic contexts.
- Partnership for 21st Century Learning (P21, 2009) identified key 21st-century skills such as critical thinking, creativity, communication, and collaboration. The framework suggests that these skills are essential for success in modern society.
- Organisation for Economic Co-operation and Development (OECD, 2018) emphasized global competence, problem-solving, and lifelong learning under its Education 2030 framework, supporting integrated and competency-based education.
- John Dewey (1938) argued that experiential learning and real-life problem solving are essential for developing thinking skills and democratic values in students.

Recent educational reforms in India emphasize the importance of multidisciplinary and skill-oriented learning in school education. The **National Education Policy 2020** highlights the need to transform traditional teaching practices that rely heavily on rote memorization and fragmented subject knowledge. The policy advocates a shift toward experiential, inquiry-based, and integrated learning approaches that promote critical thinking, creativity, communication, and problem-solving among learners. It encourages schools to adopt multidisciplinary and holistic educational frameworks where knowledge from different disciplines can be connected to real-life contexts (Government of India, 2020). Such reforms aim to prepare students for the demands of the twenty-first century by fostering deeper understanding, collaborative learning, and practical application of knowledge. In this regard, transdisciplinary learning aligns closely with the vision of NEP 2020, as it integrates ideas across subject boundaries and encourages learners to address complex real-world issues through inquiry, collaboration, and reflective thinking.

- Statement of the Problem

Despite increasing policy emphasis on transdisciplinary and skill-based education, limited qualitative research investigates how 21st-century skills are developed in actual transdisciplinary classroom settings, particularly from the perspectives of teachers and students. Therefore, there is a need to explore the processes, practices, and experiences that influence skill development in such learning environments.

- Significance of the Study

The current research aims to bridge the gap between educational policy and classroom practice. Although transdisciplinary education is widely promoted in policy frameworks, there is a lack of sufficient experience

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

regarding its practical implementation and impact on skill development.

By exploring teachers' pedagogical practices and students' experiential perspectives, this study will provide valuable qualitative insights into the process of 21st century skill formation. The findings of this study can help teachers design more effective transdisciplinary strategies, inform teachers' professional development programs, and guide curriculum reform initiatives. Furthermore, this study will contribute to the growing body of literature on skill-based and integrated learning in contemporary reform contexts.

- Objectives of the Study
- To understand the concept of transdisciplinary learning in classroom education.
- To explore the pedagogical practices in Transdisciplinary Classrooms contribute to 21st-Century Skill Development.
- To analyse the learners' experiences and perceptions regarding the development of 21st-century skills in transdisciplinary learning environments.
- To identify the challenges and opportunities faced by teachers and students in implementing and experiencing transdisciplinary pedagogy for 21st-century skill development.

III. METHODOLOGY

The present study uses a qualitative descriptive research design. It follows an explanatory approach to understand the different concepts, experiences and perspectives related to transdisciplinary teaching and the development of 21st century skills.

This study is mainly based on secondary data sources, such as academic journals, research articles, books, policy documents and other scholarly publications related to transdisciplinary education and skills-based learning. Through thematic analysis of these sources, the study attempts to identify important concepts, teaching practices, students' experiences and challenges associated with the application of transdisciplinary approaches in educational settings.

IV. ANALYSIS

➢ *Objectives-1: To Understand the Concept of Transdisciplinary Learning in Classroom Education.*

This objective aims to develop a clear conceptual understanding of *transdisciplinary learning* as it functions in real classroom settings. It involves examining how knowledge from different subjects is combined to solve authentic, real-world problems, rather than teaching them in isolation. It emphasizes understanding the characteristics, processes, teacher roles, and student experiences.

Table 1 Conceptual Understanding with Real Examples

Conceptual Component	Explanation in Classroom Context	Real Classroom Example
Integration of Subjects	Knowledge from multiple subjects is combined around a common problem.	A project on **"Water Conservation"** integrates Science (water cycle), Mathematics (measuring usage), Social Science (community impact), and Language (report writing).
Real-World Problem Focus	Learning begins with a real-life issue rather than a textbook chapter.	Students investigate water wastage in their school and suggest practical solutions.
Inquiry-Based Approach	Students ask questions, research, and explore solutions.	Learners conduct surveys, collect data, and interview school staff about water use.
Collaboration	Students work in groups and share responsibilities.	Teams design posters, presentations, and awareness campaigns.
Teacher as Facilitator	The teacher guides discussion instead of delivering only lectures.	The teacher helps students connect science concepts with mathematical data analysis.
Skill-Oriented Learning	Focus shifts from memorizing content to applying knowledge.	Students develop problem-solving and communication skills while presenting findings.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

Table 2 Conceptual Flow of Transdisciplinary Learning

Traditional Classroom	Transdisciplinary Classroom
Subjects taught separately	Subjects integrated around a theme
Focus on textbook content	Focus on real-life application
Teacher-centered instruction	Student-centered inquiry
Emphasis on memorization	Emphasis on understanding, skill development, and experience building.

Understanding this concept involves examining how transdisciplinary classrooms emphasize integration, collaboration, inquiry, and real-life application. It also requires distinguishing transdisciplinary learning from traditional subject-based instruction, where knowledge is fragmented and often limited to textbook content. By exploring classroom practices and learner engagement, this objective aims to clarify how transdisciplinary education creates meaningful learning experiences that support deeper understanding and skill development.

- *Objectives-2: To Explore the Pedagogical Practices in Transdisciplinary Classrooms Contribute To 21st-Century Skill Development.*

This objective seeks to explore the pedagogical practices employed within transdisciplinary classrooms that foster 21st-century skill development. Transdisciplinary education emphasizes the collaboration of multiple disciplinary perspectives organized through relevant themes and authentic contexts beyond the isolation of separate subject. In these environments, educators craft intentional learning experiences that offer project-based learning, collaborative inquiry, problem-centered work as well as relevant real-world engagement. These pedagogies situate students as co-creators of knowledge while promoting intellectual independence, shared ownership of learning and reflection.

By engaging over time of with complex, interdisciplinary problems, students develop higher-order competencies such as critical thinking, creativity, collaboration, communication and adaptive problem-solving. This purpose thus seeks to produce an extensive comprehension of the connection between integrated pedagogical design and holistic development of significant 21st-century skills, locating classroom practice in large-scale transformation proposals.

Table 3 Pedagogical Practices and Skill Development

Teaching Strategy	Description in Transdisciplinary Classroom	21st-Century Skills Developed	Real Classroom situation
Inquiry-Based Learning	Students investigate real-world questions across subjects	Critical Thinking	Investigating causes and solutions of air pollution in the local area and have an acceptable solution of the Problem.
Project-Based Learning	Students work on extended projects integrating multiple subjects	Critical Thinking, Creativity, Problem-Solving	Designing a sustainable school garden integrating Science, Math, and Environmental Studies
Collaborative Inquiry	Students investigate questions in groups through research and discussion	Collaboration, Communication	Group research on renewable energy sources and presenting findings
Problem-Solving Tasks	Students address real-world challenges requiring analytical thinking	Critical Thinking, Problem-Solving	Creating a plan to reduce plastic waste in the community
Real-World Integration	Learning connected to authentic community or global issues	Application Skills, Creativity	Developing an awareness campaign on water conservation
Reflective Dialogue	Students reflect and share insights about their learning process	Communication, Metacognition	Class discussion on lessons learned from a sustainability project

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

As shown in the table above, pedagogical practices impact the development of 21st-century skills directly in a transdisciplinary classroom. This objectives sets aims to understand how integrated pedagogy feeds into holistic competencies by exploring and narrowing down these structured teaching practices.

- *Objectives-3: To Analyze the Learners' Experiences and Perceptions Regarding the Development of 21st-Century Skills in Transdisciplinary Learning Environments.*

This objective seeks to explore and interpret learners' lived experiences within transdisciplinary classrooms, particularly in relation to the development of 21st-century skills. Students actively participate in integrated projects, collaborative inquiry, and real-world problem-solving tasks, which shape their perceptions of learning. Their reflections, attitudes, engagement levels, and feedback provide meaningful insights into the effectiveness of transdisciplinary pedagogy. By focusing on learners' voices, this objective aims to develop a comprehensive understanding of how critical thinking, creativity, communication, collaboration, and problem-solving skills evolve through authentic interdisciplinary experiences. It also considers the challenges, motivations, and transformative moments that influence students' competency development.

Table 4 Learners' Experiences and 21st-Century Skill Development

Learners' Experience	**Nature of Perception**	**21st-Century Skill Developed**	**Illustrative Example**
Participation in Group Projects	Feeling of shared responsibility and teamwork	Collaboration	Students dividing roles while designing a community awareness campaign
Engaging in Inquiry-Based Tasks	Curiosity and deeper understanding of concepts	Critical Thinking	Investigating causes of local environmental problems
Presenting Ideas Publicly	Increased confidence and clarity of expression	Communication	Classroom presentation on sustainable development solutions
Designing Creative Solutions	Sense of innovation and ownership of learning	Creativity	Creating a prototype model for waste management
Solving Real-Life Problems	Practical application and analytical thinking	Problem-Solving	Developing strategies to reduce water wastage in school

As the table illustrates, learners' perceptions of skill development rely heavily on their experiences in transdisciplinary classrooms. This goal examines how authentic interdisciplinary learning correlates with the development of critical 21st-century skills through student reflections and engagement patterns. It is learners' voices that become central to interpreting the impact of transdisciplinary pedagogy on holistic skill development.

- *Objectives-4: To Identify the Challenges and Opportunities Faced by Teachers and Students in Implementing and Experiencing Transdisciplinary Pedagogy For 21st-Century Skill Development.*

This objective seeks to explore and discuss the challenges and opportunities that teachers and students face in transdisciplinary learning environments. Transdisciplinary pedagogy has much promise in developing skills for the 21st century, but this may be complicated structurally as well as practically, through pedagogical issues and by relevant local contexts. Teachers might not be able to provide all options due to curriculum rigidity, time constraints, assessment limitations, and lack of interdisciplinary training. Likewise, students may hit some initial confusion or adjustment issues and may struggle with collaborative coordination.

At the same time there are opportunities for meaningful engagement, authentic learning, professional growth, and enhanced skill acquisition within transdisciplinary classrooms. Teachers then benefit from flexibility to design innovative learning experiences, while students advance their understanding of concepts and holistic competency development through interactive activities. The aim of this objective is to identify constraints and enabling factors, which provides a balanced, well-rounded understanding of the practical realities of the development of 21st-century skills in transdisciplinary settings.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

Table 5 Challenges and Opportunities in Transdisciplinary Pedagogy

Stakeholder	Challenges Faced	Opportunities Created	Impact on 21st-Century Skills
Teachers	Limited interdisciplinary training	Professional growth through collaborative planning	Improved instructional innovation
Teachers	Curriculum rigidity and time constraints	Flexibility in integrating real-world themes	Enhanced creativity in teaching
Students	Difficulty adapting to integrated learning	Exposure to authentic problem-solving	Strengthened critical thinking
Students	Group coordination issues	Development of teamwork abilities	Improved collaboration skills
Both	Assessment challenges	Adoption of performance-based evaluation	Better measurement of communication and application skills

This table shows that the implementation of transdisciplinary teaching involves both significant challenges and meaningful opportunities. By identifying these issues, this objective contributes to a deeper understanding of the contextual and practical situations that shape 21st century skills development. Recognizing these dynamics helps inform strategies to strengthen transdisciplinary classroom practices and ensure effective skills development.

V. INTERPRETATIONS OF THIS STUDY

The objective findings of the study indicate that there is a consistent relationship between transdisciplinary learning frameworks and the development of 21st century skills. Conceptual analysis shows that, in contrast to the fragmentation of subject-based instruction, transdisciplinary learning integrates knowledge around real-world issues. This integration creates real-life learning environments where students naturally use analytical, creative, problem-solving, and collaborative skills.

Investigations of educational practice suggest that methods such as project-based learning, inquiry-driven work, and reflective dialogue are effective tools for developing skills. These teaching methods position students as active rather than passive recipients of knowledge. Through prolonged engagement with interdisciplinary problems, students learn to think critically and adaptively and therefore develop higher-level skills such as problem solving.

This interpretation is echoed in the students' experiences. Students' opinions suggest increased confidence and responsibility for learning, as well as shared skills in transdisciplinary settings. Their view suggests that skill development occurs not only through instructional design but also through practice and participation.

However, the recognition of challenges uncovers relevant complexities. It creates a framework for constraints on teachers, where curricula are rigid, and teachers have limited interdisciplinary training, and students face early adjustment processes. The aforementioned challenges are outweighed by meaningful opportunities for authentic learning, professional development opportunities, and skill development in the context of relevant support.

Overall, this interpretation suggests that interdisciplinary teaching can serve as an enabling framework for facilitating the formation of holistic skills, as long as institutional, pedagogical, and assessment reforms meet competency-based objectives.

VI. CONCLUSION

Importantly, the current study highlights the key role of transdisciplinary learning and the criticality of it to developing the skills of the 21st century in modern education. Transdisciplinary classes are able to engage learners from multiple fields and connect learning to the real world: They help students to gain critical thinking, creativity, to learn to collaborate, communicate and to apply to real-life applications.

The results suggest that project-based learning, collaborative inquiry, and real context use play a key role in promoting the acquisition of these competences. The active involvement and opportunity to explore issues across disciplinary boundaries also seem to result in more productive individual and collective learning, according to students' experiences.

Yet, the successful realization of transdisciplinary learning faces other structural impediments as well. This is due to rigid curriculum arrangements, limitations in traditional assessment practices, and inadequate professional growth of teachers. Educational reform measures should therefore direct attention at providing coherent, consistent institutional back-up so that transdisciplinary practices are able to be used in classroom teaching.

To sum up, transdisciplinary studies should not only be conceived as an innovative teaching methodology, but it

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr099

also a paradigm shift in educational practice. Taken carefully and given the right support, it meets the evolving requirements of 21st century education and provides an opportunity for learning and for developing young students' needed skills along the way: when applied with care and support.

In conclusion, transdisciplinary learning should not be viewed only as a new instructional approach but as a broader shift in educational thinking and practice. When implemented carefully and supported appropriately, it responds to the changing needs of twenty-first-century education and offers a meaningful pathway for developing essential skills and preparing learners for lifelong learning.

REFERENCES

[1]. Boix Mansilla, V. (2010). Learning to synthesize: The development of interdisciplinary understanding. In R. Frodeman (Ed.), *The Oxford handbook of interdisciplinarity* (pp. 288–306). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199236916.013.0022

[2]. Care, E., Griffin, P., & Wilson, M. (2018). *Assessment and teaching of 21st century skills: Research and applications*. Springer. https://doi.org/10.1007/978-3-319-65368-6

[3]. Dewey, J. (1938). *Experience and education*. Macmillan. https://doi.org/10.1093/0195061574.001.0001

[4]. Drake, S. M., & Burns, R. C. (2004). *Meeting standards through integrated curriculum*. ASCD. https://www.ascd.org/books/meeting-standards-through-integrated-curriculum

[5]. Drake, S. M., & Reid, J. (2018). Integrated curriculum as an effective way to teach 21st century capabilities. *Asia Pacific Journal of Educational Research, 1*(1), 31–50.

[6]. Government of India. (2020). *National Education Policy 2020*. Ministry of Education, Government of India. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

[7]. Nicolescu, B. (2002). *Manifesto of transdisciplinarity* (K.-C. Voss, Trans.). State University of New York Press. https://doi.org/10.1353/book.2976

[8]. Organisation for Economic Co-operation and Development (OECD). (2018). *The future of education and skills: Education 2030*. OECD Publishing. https://www.oecd.org/education/2030-project

[9]. Organisation for Economic Co-operation and Development (OECD). (2019). *OECD learning compass 2030: A series of concept notes*. OECD Publishing. https://www.oecd.org/education/2030-project/learning-compass-2030

[10]. Partnership for 21st Century Learning. (2009). *Framework for 21st century learning*. https://www.battelleforkids.org/networks/p21/frameworks-resources

[11]. Piaget, J. (1972). The epistemology of interdisciplinary relationships. In L. Apostel, G. Berger, A. Briggs, & G. Michaud (Eds.), *Interdisciplinarity: Problems of teaching and research in universities* (pp. 127–139). Organisation for Economic Co-operation and Development. https://unesdoc.unesco.org/ark:/48223/pf0000006893

[12]. Saavedra, A. R., & Opfer, V. D. (2012). Teaching and learning 21st century skills: Lessons from the learning sciences. Asia Society. https://asiasociety.org/files/rand-1012report.pdf

[13]. Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. Jossey-Bass. https://doi.org/10.1002/9781118269411