Proceedings of the
7th International Conference on Mechanical Engineering and Renewable Energy 2024
(ICMERE2023) 16-18 November 2023, Chattogram, Bangladesh

ICMERE2023-PI-114

Empowering Youth Through Team-Based Online Projects (TOP): Addressing Rural Issues and Fostering Awareness

Ashish[1], and **Saha, S. K.**[2]

[1]Project Assistant, Indian Institute of Technology Delhi, India
[2]Professor, Indian Institute of Technology Delhi, India
[1]iitdmashish@gmail.com, [2]saha@iitd.ac.in

Abstract-*The emergence of Team-based Online Projects (TOP), conceptualized by the second author during the pandemic, represents an innovative approach to addressing contemporary educational and collaborative challenges. This paper explores the TOP framework's successful implementation, which involves dividing participants into teams, each with a coordinator, for collaborative online projects. Teams choose project topics, ranging from literature searches to algorithm development, and engage in interdisciplinary activities, eventually making the students aware of the community-related problems. Team presentations are uploaded and peer-reviewed, fostering valuable interactions. TOP offers numerous advantages. Participants expand their networks, enhance teamwork and presentation skills, and engage in peer learning. The framework encourages future collaborations and partnerships between participants from different backgrounds. By enabling the concept to the students to engage with community-related issues, TOP helps bridge the gap between their academic knowledge and the practical needs of the community, fostering greater awareness and understanding. Participant feedback emphasizes the interdisciplinary exchange of ideas, improved teamwork, and communication skills. The gained experiences fuel future research and innovation. This paper underscores TOP's role in raising rural awareness while cultivating a collaborative learning environment. In essence, TOP empowers youth and contributes to holistic learning.*

Keywords: Team-based Online Projects (TOP), Rural problem awareness, Collaborative learning, Youth empowerment.

1. INTRODUCTION

The Rural Technology Action Group (RuTAG) Internship program is a pivotal platform to bridge the gap between technological advancements and rural challenges. To further involve students from the Indian Institute of Technology Delhi (IITD) and enhance their awareness regarding rural issues and technological solutions, the second author embarked on a transformative journey by introducing the RuTAG Internship program in June 2021 [1]. A fundamental pillar of this visionary initiative is integrating the Team-based Online Projects (TOP) framework [2], which encompasses collaborative learning, practical application, and problem-solving. The RuTAG Internship program, supported by the TOP framework, allows students to engage with real-world issues and fosters a symbiotic relationship between academia, technology, and societal development.

Within this framework, students are not mere observers of theoretical concepts but active participants in addressing pressing rural challenges. This paper explores how the RuTAG Internship, shaped by the TOP framework, fosters collaborative teamwork, experiential learning, and a sense of responsibility. By exploring the evolution, principles, and outcomes of this integration, we illuminate how the RuTAG Internship cultivates a holistic educational experience that nurtures both intellectual growth and social consciousness. Through an in-depth analysis, this paper sheds light on the transformative potential of merging the TOP framework with the RuTAG Internship, paving the way for a new era of technologically savvy, socially aware students poised to contribute substantially to rural upliftment and societal progress.

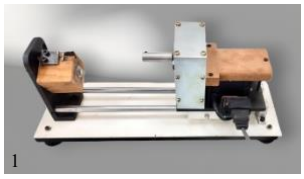
2. BACKGROUND AND CONTEXT

In the dynamic landscape of technological advancement and societal progress, RuTAG aims to bridge the gap between rural challenges and technological solutions. RuTAG aims to make modern technology accessible to rural communities, promoting inclusivity and empowerment. In 2004, the Rural Technology Action Group (RuTAG) was established by the office of the Principal Scientific Advisor (PSA) at IIT Madras. It has been operating smoothly and expanding its reach to various IITs in India. RuTAG IIT Delhi was established in 2009 [5], [6]. Since then, it has remained committed to

© ICMERE2023

fulfilling its mission, which is outlined below.

Over the years, RuTAG has been consistently engaged in the development of diverse technologies aimed at enhancing the well-being of rural communities. Among its notable achievements are the successful creation of innovative devices such as the Sheep Hair Shearing Device, which mechanizes the removal of woolen fleece from the body of the sheep, the Tulsi Mala Making Device (Fig. 1), which facilitates the crafting of traditional prayer garlands, and the Treadle Pump (Fig. 2), a resourceful tool for efficient water pumping [5], [7], [8]. These accomplishments underscore RuTAG's commitment to bridging technological gaps and addressing the unique challenges faced by rural areas, thereby fostering sustainable progress and empowerment.





Figs. 1 and 2: Tulsi Mala Bead Making Device (AC Motor), and Treadle Pump

The RuTAG Internship program, which began in June 2021, combines education and social impact. It represents a new approach to learning by providing students with practical experiences that complement theoretical knowledge. The internship emphasizes empathy, innovation, and problem-solving skills for rural challenges. A crucial component of the RuTAG Internship's success is the incorporation of the Team-based Online Projects (TOP) framework. This framework is particularly well-suited to addressing the complex and multifaceted issues that arise in rural contexts. By encouraging teamwork, interdisciplinary learning, and ongoing refinement of ideas, the TOP framework supports the internship's goals and objectives.

3. THE TOP FRAMEWORK

During the difficult time of the COVID-19 pandemic, the innovative concept of Team-based Online Projects (TOP) was developed by the second author. This was first introduced in June 2020 during a Faculty Development Programme (FDP) at NIT Jamshedpur. The TOP framework (Fig. 3) had a significant impact on various educational institutions and events that followed [9]. Since then, its use has spread to many platforms, including notable examples like organizing RoboAnalyzer-based Online Competitions by Tezpur University [3], collaborative ReDySim-based online competitions organised jointly by IIT Delhi and Jodhpur [4], and later shaping the RuTAG Internship program [2].

In various situations, the TOP framework has received praise and recognition for its capacity to go beyond one specific program and apply to various contexts. The fact that TOP has spread organically to different institutions and activities shows its flexibility and importance, especially in a constantly changing and difficult educational environment.

The TOP (Team-based Online Projects) framework plays a crucial role in contemporary education by promoting teamwork, creativity, and analytical thinking. Based on experiential learning and collaborative problem-solving, the TOP framework provides a well-organized approach that surpasses conventional limitations. Essentially, the framework motivates students to participate actively, stay engaged, and acquire important skills that go beyond textbooks.

Collaboration stands as a defining feature of the TOP framework, which intricately weaves together participants into teams, fostering an environment of collective learning and problem-solving. Since RuTAG projects are community-based, this mimics real-world scenarios, where a mosaic of diverse perspectives converges, learn collectively, and collectively raise awareness while crafting pragmatic solutions. Beyond this, the framework serves as a nurturing ground for peer learning, inspiring participants to critically assess and glean insights from their peers' endeavours. This practice, in turn, instils a culture of continuous refinement and enhancement, emblematic of the framework's commitment to growth and innovation.

The TOP framework prepares participants for the modern professional landscape with an emphasis on online engagement, where virtual collaboration is increasingly prevalent. The integration of technology into the learning process not only enhances accessibility but also aligns with the evolving dynamics of education and work.

In the context of the RuTAG Internship program, the TOP framework becomes a catalyst for students to bridge the gap between theoretical knowledge and practical application. Its principles resonate with RuTAG's mission to address rural challenges through collaborative demand-driven solutions. By immersing students in a holistic learning experience, the TOP framework empowers them to become active contributors to societal progress.

The following outlines the fundamental components of the TOP framework:

© ICMERE2021

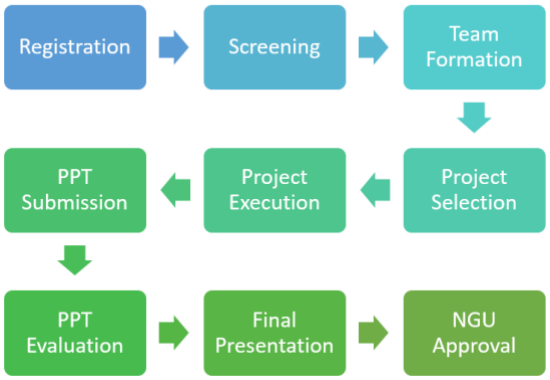


Fig. 3: TOP Framework

a. Team Formation: At the core of TOP is the arrangement of students into compact teams, usually consisting of 4-5 members. One member is designated as team coordinator by the organizer. This structure fosters efficient collaboration, enabling participants to cooperate and gain insights from one another as they navigate the project's evolution. Since students come from diverse disciplines and lands, the knowledge exchange takes on a comprehensive character, contributing to their collective learning experience.

b. Project Selection: Engaging in RuTAG projects centered around diverse themes, students delve into topics frequently predetermined to match the overarching objectives of the educational endeavor. These project subjects encompass a wide spectrum, from literature exploration to crafting algorithms and design synthesis.

c. Online Meetings: A vital aspect of the TOP journey involves placing a strong focus on consistent, real-time communication. Teams meet at frequent intervals individually, on a weekly basis, leveraging online platforms to discuss project advancements, share insights, and collaboratively reach decisions. These virtual gatherings nurture active involvement and guarantee a harmonized and united team endeavor. Subsequently, common meetings are arranged, where all teams come together to showcase their solutions, discuss project advancements, raise inquiries, and more. This creates an environment in which every student can absorb insights from all projects, familiarize themselves with various presentation styles, and much more.

d. Project Execution: Depending on the project type chosen, teams engage in comprehensive research, analysis, problem-solving, and assessment of existing solutions. The flexible online nature of TOP projects empowers participants to leverage a wide range of digital resources, tools, and collaborative platforms, thereby enhancing project outcomes.

e. Presentation Development: Teams distill their project findings into concise presentations. These presentations, often limited to a few slides (6), are crafted to effectively convey the project's objectives, study of problem, methodologies, key findings, and potential implications.

f. Peer Review: A hallmark of TOP, the peer review phase involves teams critically evaluating presentations of other teams. This crucial step promotes a culture of constructive feedback and encourages participants to gain insights from diverse perspectives, fostering a deeper understanding of the subject matter. For example, one team will evaluate the presentations from the next 3-5 teams or even more depending on the situation.

g. Feedback and Interaction: Following the receipt of peer reviews, teams incorporate feedback into their projects, thereby refining their work iteratively. This iterative process underscores the commitment to continuous improvement and the eagerness to learn from one another.

h. Presentation and Discussion: Culminating the TOP journey, teams present their refined projects to the organizers and the entire participant group. This step enables cross-pollination of ideas, knowledge sharing, and lively discussions, fostering a dynamic exchange of insights.

i. Networking and Collaboration: Beyond the immediate project scope, the TOP framework facilitates networking opportunities. Participants forge connections with peers from diverse backgrounds, laying the foundation for potential collaborations that extend beyond the confines of the project itself.

j. Empowerment and Awareness: By embracing the TOP framework, participants are equipped not only with essential teamwork skills and effective communication abilities but also with a heightened awareness of critical challenges, such as rural issues. This holistic approach contributes to personal growth, ethics, collaborative prowess, and an enhanced sense of societal responsibility.

4. RUTAG INTERNSHIP

The inception of the RuTAG Internship program in June 2021 marked a transformative endeavour aimed at fostering a symbiotic relationship between technological innovation and rural betterment. This program was catalysed by the professors associated with the RuTAG program of IIT Delhi as a response to the imperative of leveraging technology to address pressing rural challenges. With a deep understanding of the potential impact of higher education, the RuTAG Internship was conceptualized to equip students with practical skills while fostering a heightened awareness of rural realities.

Beyond traditional academic pursuits, the RuTAG Internship embraces a comprehensive learning experience that transcends the confines of textbooks. By embedding participants within the intricate fabric of rural communities, the program offers an immersive environment where theoretical knowledge translates into tangible solutions. The internship is a catalyst for participants to not only learn about rural problems but also actively contribute to their resolution.

© ICMERE2021

The RuTAG Internship at IIT Delhi goes beyond a fleeting engagement. The second author have envisioned a transformative journey that empowers students to become catalysts of change. By infusing the program with the essence of the TOP framework, they envisioned an innovative approach that encapsulates the power of collaborative learning, experiential engagement, and technological application.

Beyond offering a valuable learning journey and fostering societal connections, this program extends the added advantage of awarding Non-Graded Unit (NGU) credits. These credits can be strategically employed by students to contribute toward the fulfilment of their degree requirements. Notably, NGU credits hold a significant place within IIT Delhi's curriculum, constituting a mandatory component for all students. As a result, the program sees a high influx of student applications each summer, keen on benefiting from this multifaceted opportunity. For instance, the ongoing RuTAG Summer Internship 2023 has witnessed participation from an impressive cohort of over 400 students.

4.1 Integration of the Top Framework

The integration of the Team-based Online Projects (TOP) framework within the RuTAG Internship program serves as a strategic convergence of two visionary educational paradigms. The inherent synergies between the TOP framework and the RuTAG Internship's goals culminate in a transformative learning experience that transcends traditional boundaries.

The decision to infuse the TOP framework into the RuTAG Internship was driven by a shared commitment to experiential learning, collaboration, and the practical application of knowledge. The structured nature of the TOP framework aligns seamlessly with the internship's need for a systematic approach to address rural challenges. The framework's emphasis on teamwork, innovation, and iterative refinement resonates with RuTAG's mission to develop demand-driven solutions that uplift rural communities.

Within the RuTAG Internship, the TOP framework unfolds as a dynamic guide that orchestrates participants through the multifaceted stages of project selection, teamwork, solution generation, and presentation. The emphasis on regular online meetings fosters a culture of effective communication and shared decision-making, mirroring the demands of modern work environments. Moreover, the integration of the TOP framework instils participants with skills that extend beyond academic realms. By encouraging participants to evaluate each other's work through peer review, the framework nurtures critical analysis and objective assessment – qualities essential in both academia and professional life.

4.2 Academic Recognition and Beyond

The integration of the Team-based Online Projects (TOP) framework within the RuTAG Internship program not only enriches participants' learning experiences but also offers tangible academic recognition. Participants who successfully complete their projects within the TOP framework receive one (1) Non-Graded Unit (NGU) credit, signifying their active engagement and commitment to the program's objectives. This eligibility requires each student to contribute for a minimum of 40 hours during the internship.

The NGU credit serves as a testament to participants' practical learning and contributions to the RuTAG Internship. It acknowledges their dedication to solving rural challenges through collaborative, technology-driven solutions. The NGU credit thus becomes a steppingstone, symbolizing participants' readiness to engage meaningfully with complex challenges and contribute positively to society. Beyond academic recognition, the impact of the TOP framework resonates in the broader realm of participants' personal and professional development. The skills honed from teamwork and communication to critical analysis and innovation become instrumental in their future academic pursuits and careers.

4.3 Experiential Learning in Action

The confluence of the Team-based Online Projects (TOP) framework and the RuTAG Internship program materializes in a dynamic educational landscape where experiential learning takes center stage. As participants embark on this transformative journey, they navigate through the intricate phases of the framework, translating theoretical concepts into tangible solutions for rural challenges. The hands-on engagement within the TOP framework, project selection, guided by personal interests, fosters a sense of ownership and enthusiasm. The subsequent formation of teams promotes collaborative synergy, where participants learn to harness diverse skills to achieve shared goals.

Project work associated to the internship becomes an immersive experience that blends online collaboration with practical application. Students delve into honing skills that span research, analysis, and innovation. The online meetings simulate professional interactions, reinforcing the importance of communication, coordination, and time management. The pivotal phase of presentation preparation demands participants to condense their work into concise, impactful messages. This process sharpens their ability to effectively communicate complex ideas, a skill of immense value across various domains. On the other hand, peer review emerges as a cornerstone of the learning journey, where participants evaluate and critique each other's work. This nurtures objectivity and analytical thinking and exposes participants to diverse perspectives, enriching their own understanding. By tracing participants' trajectories through project selection, teamwork, and presentation, we capture the essence of the learning experience fostering skill acquisition, collaborative proficiency, and

© ICMERE2021

an empowered mindset ready to tackle real-world challenges with confidence and innovation.

4.4 Amplifying Impact: Future Collaborations and Beyond

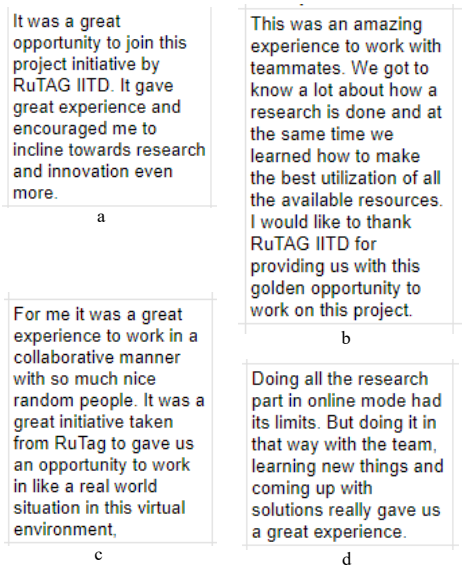
The integration of the Team-based Online Projects (TOP) framework within the RuTAG Internship program not only shapes participants' immediate learning experiences but also lays the foundation for sustainable impact and future collaborations. As participants traverse the stages of the framework, they simultaneously embark on a journey that extends far beyond the program's duration. The collaborative nature of the TOP framework serves as a catalyst for future partnerships. Participants, drawn from various departments/disciplines and various years of their studies, form connections that transcend geographical, and domain knowledge boundaries. The networking opportunities inherent in the framework set the stage for potential collaborations in research, joint projects, and knowledge exchange. The skills honed within the TOP framework from effective teamwork to critical analysis become essential tools in participants' academic and professional journeys. As they continue their educational pursuits, these skills enable participants to contribute effectively to research projects, collaborative initiatives, and their respective fields of study.

The TOP's vision in the RuTAG Internship extends beyond the confines of the program. By infusing the TOP, the authors have nurtured an ecosystem where participants are empowered to shape the future. This section delves into the lasting impact of the TOP, exploring the ripple effects that extend into participants' academic careers, professional pursuits, and collaborative endeavours, ultimately contributing to a more informed and empowered society.

5. TESTIMONIALS: VOICES OF IMPACT AND TRANSFORMATION

The success of the Team-based Online Projects (TOP) framework within the RuTAG Internship program is best illuminated through the reflections and testimonials of its participants. These narratives provide an authentic glimpse into the profound impact of the TOP framework integration on their learning journey and personal growth. Participants share accounts of how the TOP framework enabled them to delve into rural challenges with renewed enthusiasm and practical application. They highlight the collaborative nature of the framework, emphasizing how working within diverse teams exposed them to different perspectives and fostered a culture of shared problem-solving.

The extreme success of such a program can be seen when a lot of students who completed the internship in 2021 wrote such lines in the feedback (Figs. 4 a, b, c, and d).



Figs. 4 (a, b, c, and d): Feedback received from participants

The testimonials also reflect the view that students show immense interest in collaborating with external members from different domains, enabling them to exchange cross-disciplinary knowledge.

Many participants expressed their gratitude for the networking opportunities and potential future collaborations that the TOP framework facilitated [2]. They mentioned how peer reviews not only helped them refine their own work but also exposed them to innovative ideas from their peers.

6. CONCLUSIONS

The integration of the Team-based Online Projects (TOP) framework within the RuTAG Internship program serves as a testament to the power of innovative educational paradigms in shaping the future. The integration signifies a commitment to harnessing technology and collaboration to address rural challenges. The TOP framework's structured approach and experiential learning focus turns the RuTAG Internship into a journey of transformation.

Equipped with a diverse skillset upon completing the RuTAG Internship, participants evolve beyond knowledge recipients to become catalysts of change. The infusion of the TOP framework nurtures their mindset and capacities to actively contribute to societal advancement.

In essence, the integration of the TOP framework within the RuTAG Internship underscores the potential of collaborative, experiential learning to bridge the gap between academia and real-world challenges. As participants embrace their roles as catalysts for transformation, they embody the spirit of the RuTAG Internship's mission – to leverage technology for rural empowerment and create a brighter, more inclusive future.

© ICMERE2021

7. ACKNOWLEDGEMENT

We extend our gratitude to Prof. M. R. Ravi, Prof. Sangeeta Kohli, and other RuTAG Staff for their unwavering commitment to fostering innovation and societal betterment. We also acknowledge the invaluable support and participation of the students who have been part of the RuTAG Internship program.

8. REFERENCES

Website

[1] RuTAG IIT Delhi. (2021). RuTAG Internship Program. RuTAG IIT Delhi. http://rutag.iitd.ac.in/rutag/?q=top-rutag-iit-delhi#overlay-context=rutag-iitd-summer-projects%3Fq%3Drutag-iitd-summer-projects

[2] Prof. S. K. Saha, (2020). Team-Based Online Projects (TOP). http://sksaha.com/content/team-based-online-projects-top

[3] RoboAnalyzer, (2021). RoboAnalyzer-Based Online Competition (ROC). http://www.roboanalyzer.com/roc-2021.html

[4] Recursive Dynamics Simulator, (2021). ReDySim-Based Online Competition. http://redysim.weebly.com/

[5] RuTAG Compendium, (2019). A Compendium on Rural Technology Action Group (RuTAG): Demand Driven Technologies for Rural Entrepreneurships. http://rutag.iitd.ac.in/rutag/?q=rutag-compendium-0

Conference Papers

[6] Singh, Davinder Pal, et al. "Technology upgradation and entrepreneurial diffusion through rural technology action group (RuTAG) of IIT Delhi." *3rd national rural management symposium on rural entrepreneurship and enterprise for inclusive growth at KIIT School of Rural Management, KIIT University, Bhubaneshwar, India,* November. Vol. 20. 2014.

[7] Saha, Subir Kumar, and M. R. Ravi, *eds. Rural Technology Development and Delivery: RuTAG and Its Synergy with Other Initiatives.* Springer, 2019.

[8] Gupta, Raj Kumar, et al. "Improved Technologies Under the Rural Technology Action Group (RuTAG) at IIT Delhi." *Rural Technology Development and Delivery: RuTAG and Its Synergy with Other Initiatives.* Springer Singapore, 2019.

[9] Dalla, V. K., Meena, G. D., and Saha, S. K., et al. "An Innovative Education Mechanism to Enhance the Quality and Skill Set for Learning Robotics and Automation" *Online 2nd Nat. Conf. on "Innovation and Best Practices in Education", at Dr B R*

© ICMERE2021