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Original Article

Experiential Learning through Digital Mapping of Campus Trees: A QR Code–Based Teaching–Learning Initiative at Gurudas College, Kolkata

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Abstract

Experiential learning is widely recognized as a cornerstone of effective undergraduate science education, particularly in disciplines such as botany where direct engagement with living organisms enhances conceptual clarity and retention. This paper reports a teaching–learning innovation implemented as a student minor project at Gurudas College, Kolkata, where campus trees were digitally mapped using QR code technology. Scanning the QR codes provides instant access to authenticated plant information, integrating real-life observation with digital learning. Anchored in Kolb's experiential learning theory and aligned with the National Education Policy (NEP) 2020 and NAAC quality benchmarks, the project fostered active learning, digital literacy, collaboration, and environmental awareness. The paper discusses the pedagogical framework, implementation process, learning outcomes, challenges, and scalability of this low-cost, student-driven innovation.

Keywords: *Campus Biodiversity; Experiential Learning; NEP 2020; NAAC Best Practices; QR Code; Teaching–Learning Innovation*

Introduction

Higher education is undergoing a paradigm shift from teacher-centered instruction to learner-cantered, experiential, and technology-enabled pedagogies. In science education, especially botany, meaningful learning occurs when students directly engage with natural resources rather than passively receiving information (Dewey, 1986; Kolb, 2014). However, traditional classroom teaching often restricts students' exposure to living plant diversity, leading to fragmented understanding of plant form, function, and ecological relevance.

Experiential learning theory conceptualizes learning as a cyclic process involving experience, reflection, conceptualization, and experimentation (Kolb, 2014). Studies have demonstrated that experiential approaches significantly enhance student motivation, conceptual understanding, and long-term retention (Kolb & Kolb, 2005). The integration of digital tools within experiential frameworks further supports self-directed and inquiry-based learning (Beard & Wilson, 2013).

The digital revolution is transforming education by using information and communication technologies (ICTs) to improve students' learning outcomes (Criollo-C *et al*, 2021). QR (Quick Response) codes have emerged as effective tools for linking physical objects to digital content, particularly in mobile and outdoor learning environments (Law & So, 2010; Sharples *et al.,* 2016). Their application in botanical education enables learners to access plant-related information instantly while observing living

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specimens. The present paper documents a QR code–based experiential learning initiative implemented as a minor project at Gurudas College, transforming the campus into an interactive botanical learning space in alignment with NEP 2020 and NAAC best practices.

Experiential Learning as the Pedagogical Foundation

The innovation was explicitly grounded in **Kolb's Experiential Learning Cycle** (Kolb, 2014):

- ***Concrete Experience:*** Students physically interacted with campus trees during identification and tagging activities.
- ***Reflective Observation:*** Observation of morphological features and peer discussions encouraged reflective thinking.
- ***Abstract Conceptualization:*** Digital access to plant taxonomy, uses, and ecology supported conceptual understanding through online resources.
- ***Active Experimentation:*** QR code generation, lamination, and installation enabled students to apply theoretical knowledge practically.

Experiential learning approaches such as these have been shown to be particularly effective in environmental and outdoor education contexts (Tilbury, 1995). The project also resonates with Dewey's (1986) assertion that education must be rooted in experience to be meaningful and transformative.

QR code-based systems have also been used in campus ecosystems and botanical gardens to create digital plant databases and interactive identification tools, promoting self-directed learning and strengthening environmental education. Studies suggest that such approaches significantly improve student engagement, help reduce "plant blindness," and bridge the gap between field observation and digital knowledge resources (R *et al.,* 2023).

Objective, Context and Participants

Objective: The college campus, enriched with diverse tree species, functioned as a living laboratory for experiential and outdoor learning. Gurudas College has green spaces around all the three units of the campus which are intersected with public roads (De *et al,* 2019). The initiative was implemented at Gurudas College, Kolkata-700054, involving undergraduate students undertaking a minor project under faculty supervision.

Context: Student participation was structured to ensure academic rigor, collaborative engagement, and alignment with course learning outcomes. Eventually the actually tagging of the laminated QR Code sheets onto the respective trees became a part of the Students' Week Celebration during the first week of January, 2026.

Participants: The 4-year B Sc students with Botany as Major subject were involved. One student made the list of plants, mostly trees and some shrubs, under faculty supervision. The other student made the QR Codes. During the actually tagging of the Codes onto the plants all students with Botany as a subject in their curriculum participated.

Material and Methods

Identification of Campus Trees

Students conducted field-based identification of selected tree species using observable morphological characters such as leaf arrangement, bark texture, branching pattern, and overall habit. This process strengthened observation skills and botanical reasoning, which are core competencies in experiential science education (Kolb & Kolb, 2005). There was a previous publication on the checklist of trees in Gurudas College campus (Das *et al*, 2020). One student was assigned with the duty of written down the names of the trees and shrubs using the earlier publication as a guide.

Digital Integration through QR Codes

One student was assigned responsibility for generating QR codes linked to the Wikipedia pages of the identified plant species. Wikipedia was selected due to its open-access nature and suitability for introductory and interdisciplinary learners. The use of QR codes aligns with mobile learning theories that emphasize learning beyond the classroom using handheld digital devices (Sharples *et al.,* 2016; Sarker *et al.,* 2019). Other students collaboratively laminated and fixed the QR codes on the respective plants using wires.

Collaborative Installation

The QR codes were printed and laminated to enhance durability. Other students collaboratively fixed the laminated codes to the respective trees using wires, ensuring that plant tissues were not damaged. This phase emphasized ethical field practices, teamwork, and peer learning, key elements of active and collaborative learning environments (Prince, 2004; Lai & Hwang, 2015).

Results

Experiential and Active Learning

From an educational perspective, the project transformed the campus into an open, interactive botanical learning space. It encouraged self-directed learning among students, visitors, and even school children visiting the campus, who could instantly access information about plant morphology, taxonomy, ecological importance, and uses. Moreover, the initiative aligns with modern pedagogical practices by promoting interdisciplinary learning, combining botany with information technology.

Direct engagement with campus biodiversity transformed abstract botanical concepts into concrete learning experiences. Such place-based and outdoor learning strategies are known to improve student engagement and conceptual clarity.

Learning Outcomes and Educational Impact

Digital Literacy and 21st-Century Skills

Students developed practical digital competencies, including QR code generation, online information evaluation, and responsible use of open-access resources. These skills align with digital competence frameworks for educators and learners (Redecker, 2017).

Collaborative and Peer Learning

The shared responsibilities among students promoted communication, cooperation, and peer-supported learning, which have been widely recognized as effective pedagogical strategies (Prince, 2004).

Environmental Awareness and Sustainability

Close interaction with campus trees fostered environmental sensitivity and stewardship among students, supporting the goals of environmental education and education for sustainable development (Tilbury, 1995; Rieckmann, 2017).

Pictures of trees in the Gurudas College, Kolkata – 54 college campus with the QR Codes attached are given as Fig. 1 – Fig. 10.

Figure 1: *QR Code Attached to a Guava (Psidium Guajava) Tree, Called as Peyara on Bengali*

Figure 2: *QR Code Attached to a Devil's tree (Alstonia Scholaris) Tree, Called Chattim in Bengali*

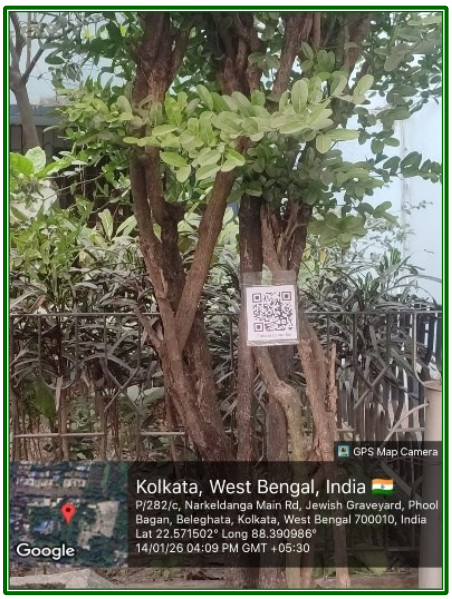

Figure 3: *QR Code Attached to a Christ's Thorn (Carissa Carandas) Plant, Called Karomcha in Bengali*

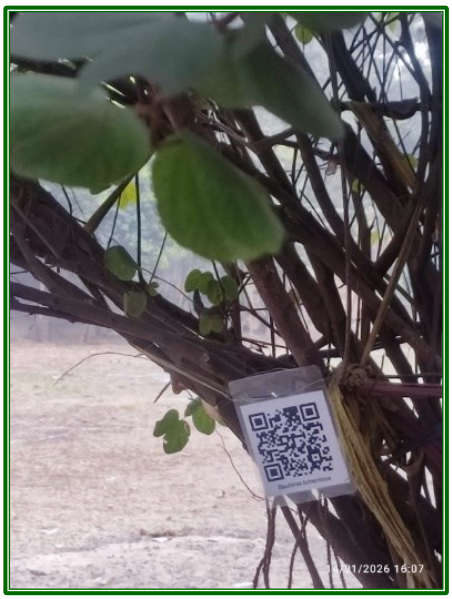

Figure 4: *QR Code Attached to a Yellow Bell Orchid Tree, (Bauhinia Tomentosa), Called as Halud Kanchan in Bengali*

***Figure 5**: QR Code Attached to a Yellow Bell Orchid Tree, (Neolamarckia Cadamba), Earlier Called as Anthocephalus Cadamba which is Called as Kadam in Bengali*

***Figure 6:** Students Using the QR Code Attached to a Tree*

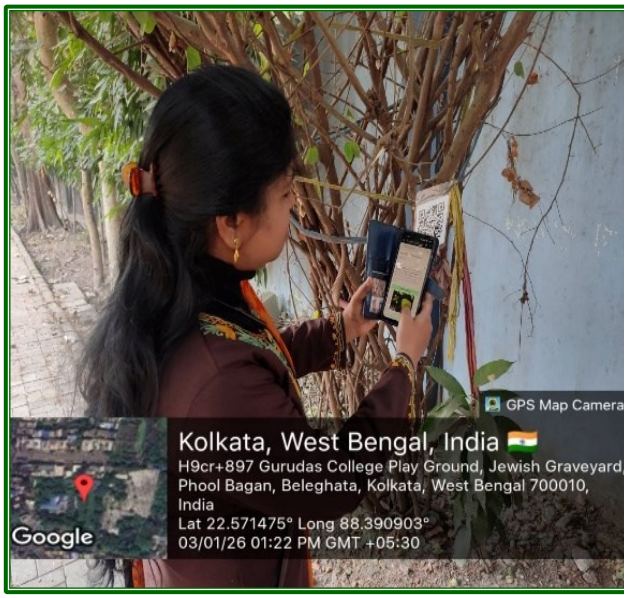

***Figure 7:** Faculty Member Using the QR Code Attached to a Tree*

***Figure 8:** QR Code Attached to a Gymnosperm, Mexican Cycad (Zamia Furfuracea)*

Figure 9: *Students Attaching the Laminated QR Codes on the Trunk of Trees Using Wires*

Figure 10: *Faculty Member Using the QR Code Attached to a Plant*

Discussion

Experiential learning is widely recognized as a cornerstone of effective undergraduate science education, particularly in disciplines such as botany where direct engagement with living organisms enhances conceptual clarity and retention. Anchored in Kolb's experiential learning theory and aligned with the National Education Policy (NEP) 2020 and NAAC quality benchmarks, the project fostered active learning, digital literacy, collaboration, and environmental awareness.

Alignment with NEP 2020

The initiative aligns strongly with key recommendations of the **National Education Policy (NEP) 2020**, including:

- *Experiential and Inquiry-Based Learning:* Emphasis on learning by doing rather than rote memorization
- *Integration of Technology in Education:* Use of digital tools to enhance learning accessibility
- *Multidisciplinary and Holistic Education:* Benefiting students beyond botany, including general campus users
- *Student-Centric Pedagogy:* Active student participation and ownership of learning

The QR code–based project operationalizes NEP 2020's vision of transforming campuses into vibrant learning ecosystems.

Alignment with NAAC Best Practices

*Under **NAAC Criteria**, The Initiative Contributes To:*

- *Criterion I (Curricular Aspects):* Innovative teaching–learning practices and experiential learning
- *Criterion II (Teaching–Learning and Evaluation):* Student engagement, participatory learning, and use of ICT
- *Criterion VII (Institutional Values and Best Practices):* Environmental consciousness and sustainability

As a documented, replicable, and low-cost innovation, this project qualifies as a **NAAC Best Practice** in teaching–learning and environmental stewardship.

QR (Quick Response) codes are increasingly being integrated into biodiversity documentation and experiential learning initiatives within college campuses in India and abroad. In India, several universities have adopted QR-based systems to digitally catalogue campus flora; for instance, large-scale biodiversity audits at the University of Mumbai have involved tagging thousands of trees with QR codes that provide instant access to taxonomic and ecological information, thereby enhancing awareness and conservation-oriented learning. More recent initiatives, such as those at Maa Manikeshwari University, demonstrate how QR codes attached to trees enable students and visitors to retrieve detailed botanical data, including scientific names and ethnobotanical uses, fostering engagement with local biodiversity (Times of India, 2021, 2024).

Challenges and Limitations

The initiative faced limitations such as dependence on internet connectivity, reliance on secondary digital sources, and the need for periodic maintenance of QR tags due to weather exposure. However, these challenges are common in outdoor digital learning environments and can be mitigated through institutional support and future upgrades.

Conclusion

The QR code–based digital mapping of campus trees at Gurudas College exemplifies how experiential learning and digital pedagogy can be effectively integrated in undergraduate education. Grounded in educational theory and aligned with NEP 2020 and NAAC quality benchmarks, the initiative transformed the campus into an interactive learning space while fostering digital literacy, collaboration, and environmental awareness. The model is scalable, sustainable, and easily replicable across higher education institutions.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this work.

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