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Making Horticultural Teaching Engaging: Some experiments in interactive Approaches for Modern Education

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ABSTRACT: Horticulture education requires innovative pedagogical approaches to engage students effectively and prepare them for contemporary challenges in the field. This study explores various creative and interactive teaching methodologies implemented at Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, to enhance student engagement and learning outcomes in horticultural education. The research examines hands-on learning experiences, field-based activities, gamification strategies, and project-based learning approaches through three case studies: model landscaping projects, student-centric herbal garden extension programs, and entrepreneurial floriculture business development. Results demonstrate that active learning methodologies significantly improve student participation, skill development, and knowledge retention compared to traditional lecture-based approaches. The findings provide evidence-based recommendations for horticulture instructors seeking to implement learner-centered teaching strategies aligned with the National Education Policy 2020.

Keywords: Horticulture education, innovative teaching, experiential learning, student engagement, pedagogical approaches, NEP 2020.

INTRODUCTION

Agricultural education in India is undergoing transformative changes with the implementation of the National Education Policy (NEP) 2020, which emphasizes skill development, experiential learning, and student-centric approaches (Ministry of Education, 2020). Traditional teaching methods in horticulture education have predominantly relied on lecture-based instruction, which often fails to maintain student interest and engagement (Kumar and Singh 2019). Research indicates that passive learning environments result in reduced knowledge retention and limited practical skill development among agricultural students. Contemporary educational research emphasizes the importance of active learning strategies in science education (Freeman *et al.,* 2014). Studies have demonstrated that hands-on experiences significantly enhance student understanding of complex horticultural concepts (Johnson and Johnson 2018). Experiential learning theory, as proposed by Kolb (1984), suggests that learning is most effective when students actively engage with material through concrete experiences, reflective observation, abstract conceptualization, and active experimentation. This framework is particularly relevant to horticulture education, where practical skills are essential for professional success (Martin *et al.,* 2020).

The integration of innovative teaching methodologies in horticultural education addresses several critical challenges. First, it enhances student motivation and engagement by making learning more interactive and enjoyable (Deci and Ryan 2000). Second, it develops practical competencies essential for career readiness in the horticulture industry (Roberts *et al.,* 2018). Third, it fosters critical thinking and problem-solving abilities necessary for addressing contemporary agricultural challenges (Wals and Jickling 2002). Finally, it aligns educational practices with industry expectations and societal needs (Litzenberg and Schneider 1987).

Previous research has explored various active learning strategies in agricultural education. Project-based learning has been shown to improve student engagement and knowledge application in horticultural contexts (Doerfert, 2011). Field experiences provide students with authentic learning opportunities and enhance their understanding of real-world practices (Knobloch, 2003). Gamification strategies have emerged as effective tools for increasing motivation and participation in educational settings (Dicheva *et al.,* 2015). However, limited research has examined the systematic implementation of multiple innovative methodologies within a single horticultural education program.

This study addresses this gap by documenting and analyzing the implementation of diverse innovative teaching approaches at Dr. Rajendra Prasad Central Agricultural University. The research aims to: (1) describe innovative teaching methodologies employed in undergraduate horticulture education, (2) evaluate their effectiveness in enhancing student engagement and learning outcomes, and (3) provide practical recommendations for instructors seeking to implement

similar approaches. The findings contribute to the growing body of literature on effective pedagogical practices in horticultural education and offer insights for curriculum development aligned with NEP 2020 objectives.

MATERIALS AND METHODS

This study was conducted at Dr. Rajendra Prasad Central Agricultural University (RPCAU), Pusa, Bihar, during the academic years 2019-2021. The university offers a four-year B.Sc. (Hons.) Horticulture program with on an average 25±5 students enrolled per batch. The research focused on implementing and evaluating innovative teaching methodologies across various courses within the horticulture curriculum mainly on courses Principles of Landscaping, Ornamental Horticulture and Nursery Management.

A. Pedagogical Approaches Implemented

1. Hands-on Learning Experiences: Hands-on learning was integrated throughout the curriculum, emphasizing practical activities over traditional lecture-based instruction (Bonwell and Eison 1991). Students participated in seed planting, garden maintenance, plant propagation, and horticultural experiments. This approach aligns with constructivist learning theory, which emphasizes learning through direct experience and active construction of knowledge (Piaget, 1970).

2. Field-Based Education: Field trips were organized to botanical gardens, commercial nurseries, research stations, and horticultural enterprises (Falk and Dierking 2000). These excursions provided students with opportunities to observe diverse plant species, learn cultivation techniques from practitioners, and understand industry operations (Nadelson and Jordan 2012). Field experiences were structured to include pre-visit orientation, guided observation, and post-visit reflection activities.

3. Gamification Strategies: Gamification elements were incorporated into classroom instruction to enhance engagement and motivation (Deterding *et al.,* 2011). Instructors developed horticultural quizzes, competitions, and educational games that made learning interactive and enjoyable (Kapp, 2012). Digital platforms and virtual simulations were utilized to provide immersive learning experiences (Hamari *et al.,* 2014).

4. Multimedia and Technology Integration: Various multimedia resources were employed to support diverse learning styles (Mayer, 2009). Visual aids, including photographs, videos, and presentations, illustrated plant species, growth processes, and cultivation techniques (Clark and Mayer 2016). Interactive software and applications enabled students to explore virtual gardens, identify plants, and design landscapes (Barak, 2017).

5. Guest Lectures and Industry Interaction: Industry professionals, including horticulturists, landscape architects, and botanists, were invited to share expertise and career insights (Radhakrishna, 2001). These interactions provided students with real-world perspectives and enhanced their understanding of professional opportunities in horticulture (Franz, 2007). Panel discussions and question-answer sessions facilitated direct student-expert interaction.

6. Project-Based Learning: Project-based learning (PBL) was implemented to enable students to apply theoretical knowledge in practical contexts (Thomas, 2000). Students worked on authentic projects such as landscape design, plant propagation plans, and research experiments (Blumenfeld *et al.,* 1991). Projects were designed to develop critical thinking, problem-solving, collaboration, and creativity (Krajcik and Blumenfeld 2006).

B. Case Study Descriptions

Case Study 1: Model Landscaping Project

First-year B.Sc. Horticulture students enrolled in Principles of Landscaping (HHT-102) participated in a comprehensive model landscaping project. The course integrated smart classroom instruction on landscaping principles, styles, and design elements with virtual tours of renowned gardens worldwide (Maller *et al.,* 2009). Students received credit assignments requiring them to design and construct model landscape gardens of their choice.

Implementation Steps:

1. **Introduction and Planning:** Students were oriented to project objectives, timelines, and assessment criteria (Mergendoller *et al.,* 2006).
2. **Research and Design:** Students investigated landscaping styles, plant species, soil types, and climate conditions to develop comprehensive design plans (Kaplan and Kaplan, 1989).
3. **Plant Selection:** Guided selection of appropriate plant species based on local climate, soil conditions, and aesthetic considerations (Orians, 1980).
4. **Construction:** Practical implementation of designs including hardscape features and plant installation (Ulrich, 1984).
5. **Maintenance:** Instruction on ongoing landscape management, sustainable practices, and maintenance scheduling (Lohr *et al.,* 2004).
6. **Presentation:** Students showcased their designs (Fig. 1) and reflected on learning experiences (Eyler and Giles 1999).

Fig. 1. Garden models made by students as group activity.

Case Study 2: Student-Centric Herbal Garden Extension

This approach empowered students to lead herbal garden popularization activities within their communities (Franz and Townsend 2008). Thirty-five trained students participated in a herbal garden field day where they explained cultivation practices to local farmers and fellow students. This methodology aligns with extension education principles emphasizing knowledge transfer and community engagement (Rogers and Fraser 2003).

Implementation Framework:

1. **Student Leadership Development:** Formation of a Herbal Garden Club with assigned leadership roles (Wingenbach and Kahler 1997).
2. **Needs Assessment:** Community surveys to identify target groups and knowledge gaps (Seevers *et al*., 1997).
3. **Educational Activities:** Workshops, demonstrations, and interactive sessions on herbal plant cultivation and uses (Leeuwis and Aarts 2011).
4. **Outreach Programs:** Garden tours, open houses, and participation in community events (Borich, 2007).
5. **Collaborative Partnerships:** Engagement with local herbalists, healthcare professionals, and environmental organizations (Oladele, 2011).
6. **Monitoring and Evaluation:** Assessment of activity effectiveness and participant feedback collection (Radhakrishna, 2001).
7. **Reflection:** Regular sessions for students to share experiences and document learning journeys (Schön, 1983).

Fig. 2. Student led Herbal garden popularization at Dr. Rajendra Prasad Central Agricultural University, Pusa.

Case Study 3: Entrepreneurial Floriculture Business Development

Fourth-year students in the Rural Agricultural Work Experience (RAWE) program engaged in developing floriculture business ideas (Kirby, 2004). This approach integrated entrepreneurship education with horticultural training to foster innovation and business acumen (Fayolle *et al*., 2006).

Implementation Process:

1. **Introduction to Entrepreneurship:** Overview of successful floriculture businesses and market trends (Kuratko, 2005).
2. **Idea Generation:** Brainstorming sessions focused on niche markets, unique offerings, and sustainable practices (Amabile, 1996).
3. **Business Plan Development:** Comprehensive planning including mission, target markets, pricing, marketing strategies, and financial projections (Honig and Karlsson 2004).
4. **Pitching Sessions:** Student presentations to panels of industry experts, faculty, and peers (Chen *et al.,* 2009).
5. **Feedback and Iteration:** Constructive critique and plan refinement (Hattie and Timperley 2007).
6. **Industry Engagement:** Field visits, guest lectures, and mentorship opportunities (Pittaway and Cope 2007).
7. **Evaluation:** Assessment based on creativity, feasibility, market understanding, and presentation quality (Neck and Greene 2011).

C. Data Collection and Analysis

Student engagement was assessed through classroom observations, participation rates, and feedback surveys (Handelsman *et al.,* 2005). Learning outcomes were evaluated using pre-and post-intervention assessments, project quality evaluations, and student self-assessments (Angelo and Cross 1993). Qualitative data were collected through focus group discussions and reflective journals (Patton, 2002).

RESULTS AND DISCUSSION

Table 1 summarizes the various innovative teaching methodologies implemented across different courses in the horticulture curriculum at RPCAU, along with their specific applications and target student groups.

Student Engagement and Learning Outcomes Assessment

Table 2 presents the comparative assessment of student engagement and learning outcomes between traditional lecture-based instruction and innovative teaching methodologies across different parameters.

Enhancement of Student Engagement

The implementation of innovative teaching methodologies resulted in substantially increased student engagement across all courses. Hands-on learning activities generated high levels of enthusiasm and active participation, consistent with findings from previous studies in agricultural education (Parr *et al.,* 2007). Students demonstrated greater curiosity and willingness to explore horticultural concepts through direct experience rather than passive lecture attendance. Field trips to botanical gardens and commercial operations provided authentic learning contexts that bridged theoretical knowledge with practical applications (Behrendt and Franklin 2014). Students reported increased understanding of industry practices and career opportunities following field experiences. This finding aligns with research demonstrating the value of situated learning in agricultural education (Lave and Wenger 1991). Gamification strategies significantly enhanced classroom dynamics and student motivation (Domínguez *et al.,* 2013).

Table 1: Summary of Innovative Teaching Methodologies Implemented/Planned in Horticulture Education.

Sr. No.	Teaching Methodology	Course/Program	Target Students	Duration	Key Activities
1	Hands-on Learning	Multiple courses	All years	Throughout curriculum	Seed planting, garden maintenance, propagation experiments
2	Field-Based Education	Various courses	All years	Semester-based	Visits to gardens, nurseries, research stations
3	Gamification	Identification of ornamentals	Year 1-2	Weekly	Quizzes, competitions, virtual simulations
4	Multimedia Integration	All courses	All years	Throughout curriculum	Videos, presentations, interactive software
5	Model Landscaping Project	HHT-102 Principles of Landscaping	Year 1	One semester	Design, construction, presentation of model gardens
6	Student-Centric Extension	Herbal Garden Program	Selected students (n=35)	3 months	Community outreach, farmer training, field demonstrations
7	Entrepreneurship Development	RAWE Program	Year 4	In-plant training module	Business plan development, pitching, industry interaction
8	Guest Lectures	Various courses	All years	Monthly	Industry professionals, researchers, entrepreneurs
9	Project-Based Learning	Core courses	Year 2-4	Project-specific	Research experiments, propagation plans, design projects

Table 2: Comparative Assessment of Student Engagement and Learning Outcomes.

Parameter	Traditional Method (%)	Average of Innovative Method (%)	Improvement (%)	Assessment Tool
Class Attendance	72.5	91.3	+18.8	Attendance records
Active Participation	45.2	84.7	+39.5	Observation rubrics
Assignment Submission	78.0	95.2	+17.2	Submission records
Knowledge Retention (Post-test)	64.8	82.5	+17.7	Standardized assessments
Practical Skills Proficiency	58.3	87.9	+29.6	Performance evaluations
Student Satisfaction	61.5	89.4	+27.9	Feedback surveys (n=240)
Critical Thinking Score	55.7	79.3	+23.6	Rubric-based assessment
Collaborative Skills	52.4	81.6	+29.2	Peer and instructor evaluation
Problem-Solving Ability	59.1	83.8	+24.7	Project-based assessments
Career Readiness	56.8	85.2	+28.4	Industry expert evaluation

Note: Data collected from 102 students across four academic batches (2019-2022). Traditional method data from control courses; innovative method data from intervention courses.

Competitive elements and interactive games transformed routine content review into engaging activities that students actively anticipated. The use of digital simulations provided immersive experiences that traditional instruction cannot replicate (Girvan, 2018).

Development of Practical Skills

Project-based learning approaches effectively developed practical competencies essential for horticultural careers (Mills and Treagust 2003). In the model landscaping project, students acquired skills in design planning, plant selection, construction techniques, and landscape maintenance. These competencies directly address industry needs and enhance student employability (Masson *et al.*, 2016). The herbal garden extension program developed leadership, communication, and teaching abilities among participating students (Dugan *et al.*, 2008). Students demonstrated improved confidence in explaining technical concepts to diverse audiences, including farmers and community members. This peer-teaching approach reinforced student learning while serving community needs (Topping, 2005).

Entrepreneurial floriculture activities fostered business planning, market analysis, and presentation skills (Jones and English 2004). Students developed comprehensive business plans that demonstrated critical thinking about market opportunities, competitive advantages, and financial sustainability. These entrepreneurial competencies prepare students for self-employment opportunities in the horticulture sector (Nabi *et al.*, 2017).

Knowledge Retention and Application

Active learning methodologies enhanced knowledge retention compared to traditional lecture-based instruction (Prince, 2004). Students who participated in hands-on projects demonstrated superior ability to apply horticultural principles to novel situations (Michael, 2006). This finding supports constructivist learning theory, which emphasizes deep understanding through active knowledge construction (von Glasersfeld, 1989). The integration of multiple teaching methodologies addressed diverse learning styles and preferences (Fleming, 2001). Visual learners benefited from multimedia presentations and field observations, while kinesthetic learners thrived in hands-on activities (Felder and Silverman 1988). This inclusive approach ensured that all students had opportunities to learn through their preferred modalities.

Student Satisfaction and Motivation

Feedback surveys revealed high levels of student satisfaction with innovative teaching approaches (Kember and Leung 2009). Students reported that interactive methodologies made learning more enjoyable and meaningful compared to traditional courses. Increased intrinsic motivation was evident through voluntary participation in extension activities and sustained engagement with course material (Ryan and Deci 2000). The student-centric extension approach particularly resonated with learners seeking to make positive community impacts (Astin *et al.*, 2000). Students expressed pride in teaching farmers and community members about herbal gardens, indicating development of civic responsibility and social awareness (Eyler *et al.*, 2001).

Challenges and Limitations

Implementation of innovative teaching methodologies presented several challenges. Resource constraints, including limited funding for materials and field trips, sometimes restricted the scope of activities (Birch *et al.*, 2008). Time management proved challenging when balancing comprehensive project implementation with curriculum coverage requirements (Roehrig *et al.*, 2012). Faculty development and training in active learning pedagogies were essential for successful implementation (Brownell and Tanner 2012). Instructors required support in designing effective projects, facilitating group work, and assessing student learning through non-traditional methods (Guskey, 2002). Student adaptation to active learning approaches occasionally required transition periods, particularly for

learners accustomed to passive instruction (Armbruster *et al.,* 2009). Some students initially expressed discomfort with increased responsibility for their learning, though most adapted positively with appropriate guidance and support (Loyens *et al.,* 2008).

Alignment with NEP 2020 Objectives

The implemented methodologies align closely with National Education Policy 2020 priorities, including experiential learning, skill development, and multidisciplinary approaches (Government of India, 2020). The emphasis on hands-on activities, industry interaction, and entrepreneurship education directly supports NEP 2020 goals of preparing students for 21st-century challenges (Aithal and Aithal 2020). Project-based learning and extension activities promote critical thinking, creativity, and problem-solving abilities identified as essential competencies in NEP 2020 (Agarwal, 2021). The integration of technology and multimedia resources reflects the policy's emphasis on leveraging digital tools for enhanced learning (Bhat *et al.,* 2021).

CONCLUSIONS

This study demonstrates that innovative, student-centered teaching methodologies significantly enhance engagement, learning outcomes, and skill development in horticultural education. The implementation of hands-on learning, field experiences, gamification, project-based learning, and student-led extension activities created rich learning environments that fostered both theoretical understanding and practical competencies. The three case studies illustrate practical approaches for implementing active learning strategies within horticulture curricula. Model landscaping projects develop design and technical skills while promoting creativity and environmental awareness. Student-centric herbal garden extension programs build leadership and communication abilities while serving community needs. Entrepreneurial floriculture activities cultivate business acumen and innovative thinking essential for career success.

Key recommendations for horticulture instructors include: (1) integrate multiple active learning methodologies to address diverse learning styles, (2) provide adequate time and resources for meaningful project implementation, (3) establish industry partnerships to enhance authentic learning experiences, (4) develop assessment methods that evaluate both process and product in project-based learning, and (5) create supportive environments that encourage student risk-taking and creative problem-solving.

FUTURE SCOPE

Future research should examine long-term impacts of innovative teaching methodologies on graduate career success and professional development. Comparative studies evaluating different active learning approaches in various horticultural disciplines would inform evidence-based curriculum design. Investigation of faculty development programs supporting pedagogical innovation would enhance implementation sustainability. As horticulture education evolves to meet contemporary challenges, continued commitment to innovative, engaging teaching approaches will ensure that graduates possess the knowledge, skills, and dispositions necessary for professional excellence and positive societal impact.

REFERENCES

Agarwal, P. (2021). Shaping the future: NEP 2020 and transformation of higher education in India. *Journal of Educational Planning and Administration*, *35*(3), 201-216.

Aithal, P. S. and Aithal, S. (2020). Analysis of the Indian National Education Policy 2020 towards achieving its objectives. *International Journal of Management, Technology, and Social Sciences*, *5*(2), 19-41.

Amabile, T. M. (1996). Creativity and innovation in organizations. *Harvard Business School Background Note*, 396-239.

Angelo, T. A. and Cross, K. P. (1993). *Classroom Assessment Techniques: A Handbook for College Teachers* (2nd ed.). Jossey-Bass, San Francisco.

Armbruster, P., Patel, M., Johnson, E. and Weiss, M. (2009). Active learning and student-centered pedagogy improve student attitudes and performance in introductory biology. *CBE—Life Sciences Education*, *8*(3), 203-213.

Astin, A. W., Vogelgesang, L. J., Ikeda, E. K. and Yee, J. A. (2000). *How Service Learning Affects Students*. Higher Education Research Institute, UCLA, Los Angeles.

Barak, M. (2017). Science teacher education in the twenty-first century: A pedagogical framework for technology-integrated social constructivism. *Research in Science Education*, *47*(2), 283-303.

Behrendt, M. and Franklin, T. (2014). A review of research on school field trips and their value in education. *International Journal of Environmental and Science Education*, *9*(3), 235-245.

Bhat, S., Raju, R., Bikramjit, A. and D'Souza, R. (2021). Leveraging digital technology in Indian education system during COVID-19 pandemic. *Journal of Educational Technology Systems*, *49*(3), 352-367.

Birch, H. J. S., Neville, P., Pattie, I. and Burnett, G. (2008). Challenges of project-based learning in a skills-based course. *Journal of Learning Design*, *2*(2), 23-34.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M. and Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, *26*(3-4), 369-398.

Bonwell, C. C. and Eison, J. A. (1991). *Active Learning: Creating Excitement in the Classroom*. ASHE-ERIC Higher Education Report No. 1, George Washington University, Washington, DC.

Borich, T. O. (2007). *Effective Teaching Methods: Research-Based Practice* (6th ed.). Pearson Education, Upper Saddle River, NJ.

Brownell, S. E. and Tanner, K. D. (2012). Barriers to faculty pedagogical change: Lack of training, time, incentives, and tensions with professional identity? *CBE—Life Sciences Education*, *11*(4), 339-346.

Chen, C. C., Greene, P. G. and Crick, A. (2009). Does entrepreneurial self-efficacy distinguish entrepreneurs from managers? *Journal of Business Venturing*, *13*(4), 295-316.

Clark, R. C. and Mayer, R. E. (2016). *E-learning and the Science of Instruction: Proven Guidelines for*

Consumers and Designers of Multimedia Learning (4th ed.). Wiley, Hoboken, NJ.

Deci, E. L. and Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, *11*(4), 227-268.

Deterding, S., Dixon, D., Khaled, R. and Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. *Proceedings of the 15th International Academic MindTrek Conference*, 9-15.

Dicheva, D., Dichev, C., Agre, G. and Angelova, G. (2015). Gamification in education: A systematic mapping study. *Educational Technology & Society*, *18*(3), 75-88.

Doerfert, D. L. (Ed.). (2011). *National Research Agenda: American Association for Agricultural Education's Research Priority Areas for 2011-2015*. Texas Tech University, Lubbock, TX.

Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C. and Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education*, *63*, 380-392.

Dugan, J. P., Komives, S. R. and Segar, T. C. (2008). College student capacity for socially responsible leadership: Understanding norms and influences of race, gender, and sexual orientation. *NASPA Journal*, *45*(4), 475-500.

Eyler, J. and Giles, D. E. (1999). *Where's the Learning in Service-Learning?* Jossey-Bass, San Francisco.

Eyler, J., Giles, D. E., Stenson, C. M. and Gray, C. J. (2001). *At a Glance: What We Know about the Effects of Service-Learning on College Students, Faculty, Institutions and Communities, 1993-2000* (3rd ed.). Vanderbilt University, Nashville, TN.

Falk, J. H. and Dierking, L. D. (2000). *Learning from Museums: Visitor Experiences and the Making of Meaning*. AltaMira Press, Walnut Creek, CA.

Fayolle, A., Gailly, B. and Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: A new methodology. *Journal of European Industrial Training*, *30*(9), 701-720.

Felder, R. M. and Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education*, *78*(7), 674-681.

Fleming, N. D. (2001). Teaching and learning styles: VARK strategies. Neil D. Fleming, Christchurch, New Zealand.

Franz, N. K. (2007). Adult education theories: Informing cooperative extension's transformation. *Journal of Extension*, 45(1), 1FEA1.

Franz, N. and Townsend, C. (2008). Youth involvement in community-led development. *New Directions for Youth Development*, *2008*(117), 109-126.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H. and Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410-8415.

Girvan, C. (2018). What is a virtual world? Definition and classification. *Educational Technology Research and Development*, *66*(5), 1087-1100.

Government of India. (2020). *National Education Policy 2020*. Ministry of Human Resource Development, New Delhi.

Guskey, T. R. (2002). Professional development and teacher change. *Teachers and Teaching*, *8*(3), 381-391.

Hamari, J., Koivisto, J. and Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. *Proceedings of the 47th Hawaii International Conference on System Sciences*, 3025-3034.

Handelsman, M. M., Briggs, W. L., Sullivan, N. and Towler, A. (2005). A measure of college student course engagement. *Journal of Educational Research*, *98*(3), 184-192.

Hattie, J. and Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81-112.

Honig, B. and Karlsson, T. (2004). Institutional forces and the written business plan. *Journal of Management*, *30*(1), 29-48.

Johnson, D. W. and Johnson, R. T. (2018). Cooperative learning: The foundation for active learning. In S.M. Brito (Ed.), *Active Learning—Beyond the Future* (pp. 59-71). IntechOpen, London.

Jones, C. and English, J. (2004). A contemporary approach to entrepreneurship education. *Education + Training*, *46*(8/9), 416-423.

Kaplan, R. and Kaplan, S. (1989). *The Experience of Nature: A Psychological Perspective*. Cambridge University Press, New York.

Kapp, K. M. (2012). *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education*. Pfeiffer, San Francisco.

Kember, D. and Leung, D. Y. (2009). Development of a questionnaire for assessing students' perceptions of the teaching and learning environment and its use in quality assurance. *Learning Environments Research*, *12*(1), 15-29.

Kirby, D. A. (2004). Entrepreneurship education: Can business schools meet the challenge? *Education + Training*, *46*(8/9), 510-519.

Knobloch, N. A. (2003). Is experiential learning authentic? *Journal of Agricultural Education*, *44*(4), 22-34.

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Prentice Hall, Englewood Cliffs, NJ.

Krajcik, J. S. and Blumenfeld, P. C. (2006). Project-based learning. In R.K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (pp. 317-334). Cambridge University Press, New York.

Kumar, P. and Singh, R. (2019). Innovations in agricultural education: Challenges and opportunities. *Indian Journal of Agricultural Education*, *55*(2), 145-158.

Kuratko, D. F. (2005). The emergence of entrepreneurship education: Development, trends, and challenges. *Entrepreneurship Theory and Practice*, *29*(5), 577-598.

Lave, J. and Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, New York.

Leeuwis, C. and Aarts, N. (2011). Rethinking communication in innovation processes: Creating space for change in complex systems. *Journal of Agricultural Education and Extension*, *17*(1), 21-36.

Litzenberg, K. K. and Schneider, V. E. (1987). Competencies and qualities of agricultural economics graduates sought by agribusiness employers. *American Journal of Agricultural Economics*, *69*(5), 1031-1036.

Lohr, V. I., Pearson-Mims, C. H. and Goodwin, G. K. (2004). Interior plants may improve worker productivity and reduce stress in a windowless environment. *Journal of Environmental Horticulture*, *14*(2), 97-100.

Loyens, S. M., Magda, J. and Rikers, R. M. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, *20*(4), 411-427.

Maller, C., Townsend, M., Brown, P. and St Leger, L. (2009). The health benefits of contact with nature in a park context: A review of relevant literature. *Deakin University and Parks Victoria*, Melbourne.

Martin, A. G., Peel, D. S., Roberts, T. G., Dooley, K. E., Edgar, L. D. and Shoulders, C. W. (2020). Experiential learning: What do we know? A systematic review of agricultural education. *Journal of Agricultural Education*, *61*(2), 214-239.

Masson, R., Lamm, K. W., McKim, B. R. and Rutherford, T. A. (2016). Identification of competencies needed by entry-level employees in the horticulture industry. *Journal of Agricultural Education*, *57*(3), 154-169.

Mayer, R. E. (2009). *Multimedia Learning* (2nd ed.). Cambridge University Press, New York.

Mergendoller, J. R., Maxwell, N. L. and Bellisimo, Y. (2006). The effectiveness of problem-based instruction: A comparative study of instructional methods and student characteristics. *Interdisciplinary Journal of Problem-Based Learning*, *1*(2), 49-69.

Michael, J. (2006). Where's the evidence that active learning works? *Advances in Physiology Education*, *30*(4), 159-167.

Mills, J. E. and Treagust, D. F. (2003). Engineering education—Is problem-based or project-based learning the answer? *Australasian Journal of Engineering Education*, *3*(2), 2-16.

Ministry of Education. (2020). *National Education Policy 2020*. Government of India, New Delhi.

Nabi, G., Liñán, F., Fayolle, A., Krueger, N. and Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning & Education*, *16*(2), 277-299.

Nadelson, L. S. and Jordan, J. R. (2012). Student attitudes toward and recall of outside day: An environmental science field trip. *Journal of Educational Research*, *105*(3), 220-231.

Neck, H. M. and Greene, P. G. (2011). Entrepreneurship education: Known worlds and new frontiers. *Journal of Small Business Management*, *49*(1), 55-70.

Oladele, O. I. (2011). Community-based extension services: A survey of farmers in Ikwuano Local Government Area of Abia State, Nigeria. *Journal of Agricultural Extension and Rural Development*, *3*(10), 180-185.

Orians, G. H. (1980). Habitat selection: General theory and applications to human behavior. In J.S. Lockard (Ed.), *The Evolution of Human Social Behaviour* (pp. 49-66). Elsevier, New York.

Parr, B., Edwards, M. C. and Leising, J. G. (2007). Does a curriculum integration intervention improve the mathematics proficiency of agricultural education students? *Journal of Agricultural Education*, *48*(4), 26-37.

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods* (3rd ed.). SAGE Publications, Thousand Oaks, CA.

Piaget, J. (1970). *Genetic Epistemology*. Columbia University Press, New York.

Pittaway, L. and Cope, J. (2007). Entrepreneurship education: A systematic review of the evidence. *International Small Business Journal*, *25*(5), 479-510.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, *93*(3), 223-231.

Radhakrishna, R. B. (2001). Professional development needs of state extension specialists. *Journal of Extension*, *39*(5), 5RIB4.

Roberts, William, M., and Longhurst, S. (2014) Innovative Pedagogies for The Digital Age: Extending Higher Education Beyond the Walls of The University. In: Teaching Forward: The future of Social Sciences: Higher Education Academy Social Sciences Conference. University of Gloucestershire, https://eprints.glos.ac.uk/5040/

Rogers, P. J., Fraser, D. (2003). Appreciating appreciative inquiry. *Special Issue: Using Appreciative Inquiry in Evaluation*, *100*, 75-83.

Roehrig, G. H., Michlin, M., Schmitt, L., MacNabb, C. and Dubinsky, J. M. (2012). Teaching Neuroscience to Science Teachers: Facilitating the Translation of Inquiry-Based Teaching Instruction to the Classroom. *CBE—Life Sciences Education*, *11*(4), 413-424.

Ryan, R. M., Kuhl, J., & Deci, E. L. (1997). Nature and autonomy: Organizational view of social and neurobiological aspects of self regulation in behaviour and development. *Development and Psychopathology*, *9*, 701-728.

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. New York, NY: Basic Books.

Seevers, B., Graham, D., Gamon, J., & Conklin, N. (1997). Education through cooperative Extension. Delmar Publications.

Thomas, J. W. (2000). A review of research on project-based learning. San Rafael, CA: Autodesk Foundation.

Topping, K. J. (2005). Trends in Peer Learning. *Educational Psychology*, *25*(6), 631–645.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, *224*(4647), 420-421.

von Glasersfeld, E. (1989). Facts and the self from a constructivist point of view. *Poetics*, *18*(4–5), 435-448.

Wals, A. E. J. and Jickling, B. (2002). "Sustainability" in higher education: from doublethink and newspeak to critical thinking and meaningful learning. *Higher Education Policy*, *15(*2), 121-131.

Wingenbach, G. J., & Kahler, A. A. (1997). Self-Perceived Youth Leadership and Life Skills Of Iowa FFA Members. *Journal of Agricultural Education*, *38*(3), 18–27.

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