Areas of Research and Educational Focus

ENGINEERING EDUCATION -*With Focus on Improving Student Learning*: Collaborative-, Creative- and Innovation-Driven Learning; Constructionistic Approaches; Students-Faculty Partnerships. **NANOSTRUCTURED MATERIALS**-*With Functional Performance:* Health Care Engineering Applications including Hydrogels for clinical diagnostics, wound healing, tissue scaffolds and assisted drug delivery- **MATEMATICS-ASSISTED-MEDICINE APPROACHES (MAMA)-** *With Applications to Biophysical Systems*: Microcirculatory and renal system pathologies, arterial stenosis, kidney failure, cancer treatment by hyperthermia and chemotherapies.-**ENVIRONMENTAL CATALYSIS-** *With Application to Food, Energy, Water (FEW) Nexus:* Advanced oxidation in water, soil and air; photocatalytic clean energy production, electrokinetics-based remediation; cold plasma discharges in gas and water; development of advanced battery and fuel cell materials.

Education, Certificates & Training

- Ph.D., Chemical Engineering, Purdue University, 1990
- M.S., Chemical Engineering, Purdue University, 1987
- Postgraduate Studies Training, National Council of Research, Argentina, CONICET-UNL, 1978-1983- *Instituto de Desarrollo para la Industría Química* (INTEC), Santa Fe, Argentina.
- Chemical Engineering Degree, Universidad Nacional del Litoral (UNL), Santa Fe, Argentina, 1977, Training Equivalent to a *Minor in Heterogeneous Catalysis.*
- Certificate of English Studies, Accredited by the British Council for the Teaching of English, Anglo-Continental School of English, Bournemouth, England, 1981.
- Academic Leadership Certificate (Regent Academic Leadership Institute, RALI, and Chair Academy), 2007.
- Advanced Leadership Certificate (Chair Academy), 2010.
- Team Alchemy ™: Training Led by founder Trevor Laurence, College of Engineering, Tennessee Technological University, 2014. Coordinated by Dr. Kathy Hagler.
- Tennessee Technological University, 2014-15 Visiting Fellow Leadership Program & Certificate of the Provost Office-Faculty exchange with Middle Tennessee State University.

Honors and Awards (Selected at Tennessee Tech)

- Tennessee Technological University, Scholar-Mentor Award for excellence in teaching, research and mentoring of students and faculty, 2022. (Please see University PR at: https://www.tntech.edu/news/releases/21-22/scholar-mentor-award-winner-puts-students-in-the-drivers-seat-of-their-education.php)

- Davidson School of Chemical Engineering, Purdue University, Outstanding Chemical Engineer Alum Award for outstanding contributions in Engineering Education and for the development of the Renaissance Foundry Model, September 2021. (See University PR at: https://www.tntech.edu/grand-challenge/news/articles/arce-oche-award-10182021.php)

- American Society for Engineering Education, 2021, Thomas C. Evans Award for most Outstanding Engineering Education Paper (with Dr. Robby Sanders and Dr. Andrea Arce-Trigatti)-Fifth time

winner. (See Rural Reimaged Institute PR at: https://blogs.tntech.edu/techtimes/2021/events/faculty-success-story-thomas-c-evans-award/)

- Tennessee Technological University, Cookeville, TN. 2018. Provost Office, University Award for the Most Encouraging Faculty.
- Tennessee Technological University, Cookeville, TN. 2017. Provost Award for Excellence in Advising Students.
- American Society for Engineering Education, 2015, Zone II Best Paper Award, "The Renaissance Foundry: A Powerful Learning and Thinking System to Develop 21ST Century Da Vinci Engineers"
- American Society for Engineering Education, ASEE-SE, 2014, Thomas C. Evans Award, Best Paper for Instruction, 4th Time Winner, "Renaissance Foundry Model for Innovation-Driven and Holistic-Center Learning", (Previous Year's Recipient: 1994, 2001, 2008)
- Tennessee Technological University, Cookeville, TN. 2015, University Donald Caplenor Award for Excellence in Research. Most Prestigious Award in Research Accomplishments.
- Tennessee Technological University, Cookeville, TN. 2014, University Faculty Award for Professional Service. Most Prestigious Award for Service Accomplishments.
- Chair Academy, 2009, 2014, I. Karre Award for on Campus Leadership.
- University of New Mexico, Albuquerque, NM, 2012, (NIH Faculty Development Program) Keynote Speaker. Program supported by the National Institute of Health.
- Tennessee Technological University, Cookeville, TN. 2010, University Distinguished Faculty Fellow, Most Prestigious University Award for Advancing the University Mission.
- Chemical Engineering Association, Argentina, 2010, Opening Plenary Lecture, Biannual Meeting, Mar del Plata.
- National Science Foundation-Engineering Research Centers, Annual Meeting Plenary Lecture, Washington, DC, 2009.
- Purdue University, West Lafayette, IN, 2009, Chemical Engineering of the Future Symposium, Invited Panelist.
- Tennessee Technological University, Cookeville, TN. 2009, University QEP Award for Hi-PeLE™ Development and Personalized Class Binder, PCB, Model.
- College of Engineering, Tennessee Technological University, Cookeville, TN. 2008, Brown-Henderson Award.
- College of Engineering, Tennessee Technological University, Cookeville, TN. 2012, Leslie E. Sissom Award for Innovation in Engineering Education, Development of the MoLE-SE Platform.
- American Society for Engineering Education, SE, 2005, Mid-Career Outstanding Teaching Award

Selected Awards previous to tenure at Tennessee Tech

- Universidad Nacional de San Marcos, Lima, Perú, 2000, Invited Visiting Professor.
- Florida State University, Tallahassee, FL, 1996-1997, Developing Scholar Award, Most Prestigious Award for an Associate Professor for Excellence in Research.
- University of Cambridge, 1995, Visiting Scientist, Herschel Smith Laboratory for Medicinal Chemistry: Invitation by Lab Director, Professor Laurie D. Hall.
- University of Florida Board of Regents, 1994, University Teaching Incentive Program Award (TIPA), Most Prestigious Award for Excellence in College Teaching across the university System.
- National Research Council of Argentina,1983-1990, Member of the Scientific and Technological Research Career. Most prestigious research staff position in Argentina for a career professional.

Professional Service (Selected)

- Elected Board Member of the American Electrophoresis Society (AES), 2000-2005
- Gonzalez, J. and P. E. Arce, Editors, Technical Proceedings of the "IX Latin American Heat and Mass Transfer Congress," San Juan, Puerto Rico, October 20-22, 2002 (ISBN 0-9726071-0-2; one hundred and two technical contributions in 736 pages document).
- Arce, P. E. and A. Gaertner, Guest Editors "19th American Electrophoresis Society Conference 2002: Focus on Interdisciplinary Science," Electrophoresis, 24 No. 19-20, (2003).
- "*New Patents in Nanotechnology*", Bentham Science Publishers, Editorial Board, Invited, 2008-
- *Journal of Chemical Engineering Education*, American Society for Engineering Education, ASEE- Division of Chemical Engineering, Editorial Board, Invited (2010- 2016). Served two consecutive terms.
- *Brazilian Journal of Chemical Engineering*, Brazilian Society of Chemical Engineering – ABEQ, Editorial Board Member, Invited, (2011-).
- *Critical Conversations, Interdisciplinary Journal,* Tennessee Board of Regents, Editorial Board (2015-)
- *Environments (MDPI),* Editorial Board Member, Invited, 2018-

Recent Fund-Raising Efforts:

Dr. Arce has received either as a PI, Co-PI, or Grant Manager more than $8M USA-dollars in competitive funding from private foundations, state and international sources, and federal agencies (National Science Foundation)-Most recent examples include:

1. Tennessee Technological University, (QEP Program)- EDGE Curriculum Grant Program, CHE 1020 The Office of Creative Inquiry -*Curriculum Grant to Improve Student Immersion within the Renaissance Foundry Model* (PI, with three Co-PI: Dr. S. Jorgensen, Dr. A. Arce-Trigatti, and Dr. J. R. Sanders), Work continued to complete data collection and analysis during 2019-2020. (Total $20K, 2018-2019 Academic Year. Funded).
2. Tennessee Technological University, Renaissance *Foundry Sociocultural Elements in Ethics Proposal EDGE Curriculum Grant Program*, CHE 1020 The Office of Creative Inquiry – Quality Enhancement Plan (QEP) Awarded Summer 2019, Renaissance Foundry Research Group, PI with two Co-PI- (Dr. S. Jorgensen and Dr. A. Arce-Trigatti). Tennessee Tech University, Cookeville, Tennessee. ($8K, Funded)[1].
3. Co-sponsored (with Dr. J. R. Sanders) a Summer Research CISE-Undergraduate Grant- $4,000- Student: Holland Highsmith- Project Tittle: *"Understanding the Cleaning of Oil Spill from Bird Feathers via the Experimental Simulation of Feather-like Materials in 3D Printing and ESM Characterization*". iCube and MRC were partners. Part of the Distinction in the Major Project in Chemical Engineering. Funded.
4. Tennessee Board of Regents, TBR, Student Engagement, Retention and Success Grant, SERS*, STEM Foundry Heritage Fellows Program*, TBR, Summer 2019 Renaissance Foundry Research Group, Co-PI. ($25K, Funded).
5. Tennessee Tech University, Cookeville, Tennessee. *Developing the Facilitator of Learning for the Holistic STEM Professional Guided by the Renaissance Foundry Model,* Faculty Research Grant Office of Research, Fall 2020, PI with Dr. A. Arce-Trigatti, Co-PI. ($10K, Funded).
6. Venture Well Foundation, "*BioFoundry Design: Leveraging Biomimicry to Advance Environmental and Social Sustainability Innovation in Prototypes Developed in Foundry-Guided Undergraduate Chemical*

[1] This grant supported the renovation efforts for ChE 1020, Professional Ethics in ChE that led to the selection of Dr. Jorgensen and Dr. Arce-Trigatti as co-winners of the 2021 Sissom Award at the College of Engineering.

Engineering Courses" (Dr. P. Arce, PI with Co-PIs: Drs. A. Arce-Trigatti, S. Jorgensen, and J.R. Sanders). ($30K, Summer 2020. Funded). Please see Interview at: https://venturewell.org/chemical-engineering/

7. TBR SERS, *The Holistic Foundry Undergraduate Engaged Learners (FUEL)*, Summer 2020 Renaissance Foundry Research Group, Co-PI. ($50K, Funded).
8. TBR TN SERS, The TN Tech Science Olympiad Collegiate Scholars (SOCS) Program, submitted March 2020, $50,000, August 2020-August 2021, Director of Grants and Sponsored Programs (PI; C. Galindo, STEM Center), Co-PIs: S. Jorgensen (Chemical Engineering), A. Arce-Trigatti (C&I, College of Education). Awarded. Dr. Arce is a consulting and collaborating faculty for this grant.
9. American Society for Engineering Education (ASEE) & Lemelson Foundation-Mini-Grant: Integration of the Engineering for One Planet Model as a Structured Approach to Sustainable Design via the Renaissance Foundry, PI with Dr. J. Robby Sanders and Dr. Andrea Arce-Trigatti, CO-PIs. $8K, Awarded.
10. The National Science Foundation, NRT-FW-HTF, *"Engendering the Spirit of Gadugi at the Food-Energy-Water Nexus,"* PI (with 10 Co-PIs and Collaborators: Dr. J. Robby Sanders, Dr. Andrea Arce-Trigatti, Dr. Ada Haynes, Dr. Lauren Harding, Dr. Ruffaro Chitiyo, Dr. Troy Smith, Dr. Stephanie Jorgensen; Dr. Satish Mahayan, Dr. Jeffrey Schaeffer, and Dr. Nicky Bowman), Total $3Mx 5yrs. Awarded. *Starting date: July 1, 2022.* (Please PR at: https://www.tntech.edu/news/releases/22-23/tech-awarded-3-million-nsf-grant-for-work-in-food-energy-and-water-resources-in-rural-communities.php)

11. *Summer Students Project Supported*- Several undergraduate students have received RUE Summer URECA! Grant from the TTU Office of Research (See Undergraduate Student Supervised).

Research Focus and Mentoring Philosophy

The twenty-first century has accentuated the new realty: Demand for long-lasting solutions to Grand Challenges (USA-NA, 2017) and professional adaptability to the globalization of the economy across countries with highly dissimilar levels of resources (Florida, R., 2012). This requires a completely different strategy for the development of a new type of Science, Technology, Engineering, and Math (STEM) professional at the postsecondary level: one that is holistically skillful, adaptable, impactful to society's challenges, and with an entrepreneurial mindset (Grasso et al., 2008; National Academy of Science [NAE], 2004; Sochacka et al., 2016). To respond to this challenge, Dr. Arce (with students and collaborators) have focused on building a constructionistic-centric approach[2], i.e., the *Renaissance Foundry Model,* RFM, (Arce et al., 2015) that provides a learning platform for facilitating the formation of such new STEM professional. Guided by the RFM, Dr. Arce strives to create learning and research environments that can efficiently foster the development of such *holistic* STEM professional. His life passion has been to work at the interface of research (either technologically or educationally focused) and the improvement of student learning. Dr. Arce's basic premise is that there is no student who does not want to learn; however, they get discouraged when the curve between what they know and what they want to know is too steep and traditionally driven approaches (and instructors) do not provide the catalytic action needed to lower that slope.

[2] This approach has been largely influenced by two corner-stone ideas, e.g. the "Constructionist-driven Philosophy to Learning:" by Seymour Papert, Founder of the MIT Media Lab and author of "Mindstorms" and the "How People Learn: Brain, Mind, Experience and School" research consensus report from The National Academies of Sciences, Engineering and Medicine (NASEM) led by John Bransford who was the founding director of the Learning in Informal and Formal Environments (LIFE) Center, a National Science Foundation Science of Learning Center. The RFM strives to increase the student's understanding of the role of "community learning" and effectively incorporates student-faculty partnership (Cook-Sather, 2022) and "Group Genius" (Sawyer, 2007).

Activities in Dr. Arce's group focus on two main different but complementary pathways: a- Educational efforts both for classroom and team-centric education and b-Technical areas related to environmental mitigation of contaminants (mainly in water and soil) and health care related applications. For the first pathway, Dr. Arce leverages constructivist- and constructionistic-based theories in conjunction with best practices (i.e. *praxis*). For the second pathway, he uses a blend of mathematical-computational approaches complemented with both analytical and experimentation tools. Typical recent efforts include *a- Collaborative and innovation-centric approaches to learning, b-Environmental catalysis (with applications to photo- and electro-catalysis), and c-Mathematics-Assisted Medicine Approaches (MAMA), including functional-based nanostructured gels, integral spectral methods in cancer treatment predictions, and understanding cholesterol deposition in arteries.* Dr. Arce is an advocate of "Group's Genius"-style approaches (Sawyer, 2007), "How People Learn" (Bransford, 2000) and student-facutly partnership (Cook-Sather, 2022). He is privileged to collaborate with the "Renaissance Foundry Research Group" (RFRG, Note 1) and other distinct colleagues across multidisciplinary subjects.

Mentoring Efforts:

During his academic career (at Florida State University, Florida A&M University, and Tennessee Technological University)[3], Dr. Arce holds a strong record of mentoring students. For example, he has/is the mentor/co-mentor of one hundred ninety one (191) research and educational projects including the following categories: High School projects (5), undergraduate Honors/Distinction in the Major/ Senior Thesis (29), Master of Science Theses (37), Doctoral Dissertation (28), postdoctoral associate projects (12), undergraduate (non-thesis) research projects (41), graduate (non-thesis) research projects (16), and summer undergraduate research projects (23). A significant number of these projects are with *underrepresented student populations*. Further, his students have distinguished themselves in academia and industrial positions. For example, his undergraduate research, doctoral or postdoctoral students have successfully performed in leading companies such as Johnson Controls, General Motors (Warren, MI), IMERYS, Lhoist (Dallas, TX), Electroactive Technologies (Knoxville, TN), Mahindra (India), Merck (Boston, MA), Y-12 (Knoxville, TN), and Enevate Corporation (Riverside, CA), among other organizations. *Twenty-one of his former students and faculty mentees* are members of academic organizations either as facutly or administrators in the USA, Argentina, South Korea, Chile, and Perú.

Recent Doctoral Graduates, Selected, (Major Professor)

1. Jennifer Pascal, PhD in Engineering Program, TTU, 2011 – Associate Professor in Residence and Associate Chair, Department of Chemical Engineering, University of Connecticut, USA
2. Jyothi Simhadri, PhD in Engineering Program, TTU, 2012,-Associate in Research, Department of Chemical Engineering, Howard University, Washington, DC
3. Cynthia Torres, PhD, Env. -Sciences Program, Concentration: Chemistry, TTU, 2012- Faculty at the Department of Metallurgy, Universiidad Catolica del Norte; Directora Fundadora y Directora Ejecutiva del "Centro de Investigación Científico Tecnológico para la Minería", CICITEM, Antofagasta, Chile.
4. Parvin Golbayani*, PhD in Engineering Program, TTU, 2014- (Co-advised)-Global Quality Assurance Manager Minerals Technologies Inc., MA-USA.
5. Helen Okoye, PhD in Engineering Program, 2016- General Motors, Warren, MI-USA.
6. Rocio Tijaro-Rojas, PhD in Engineering Program, 2016- Associate Professor, Director of the División of International Relations, Universidad Nacional Arturo Pratt, Iquique, Chile (2016-2020). Independent consultant, Santa Marta, Colombia.
7. Negin Koutahzadeh, PhD in Engineering Program, TTU, 2017- Postdoctoral Fellow, University of Arkansas

[3] An overview of Dr. Arce's efforts dated previously to and at the FAMU-FSU College of Engineering tenure can be found in: Sauer, Sharon, "Pedro Arce: FAMU-FSU College of Engineering", Florida State University, 1996. (Available upon request from Dr. Arce).

(2017-18); Director of Environmental/Safety Program, (2018-2019); Assistant Professor, Department of Mechanical Engineering, (2022-), University of Alabama, Tuscaloosa, AL-USA.

8. Ashley Nastasia Allred*, PhD in Engineering Program, TTU, 2020. Y-12 Servicies, Oak Ridge, TN-USA.
9. Sunil Rawal*, PhD Env. Science, Integrated Research Concentration, 2021- USDA Department, Postdoctoral Fellow (2022-), South Carolina, USA.
10. Sabrina Bauer*, PhD Env. Science, Integrated Research Concentration, 2022- Tennessee Tech Associate in Research and Program Coordinator of the NSF-NRT Program at TTU, (2022-).

(*)-Co-advised student.

Technical and Educational Archival Publications (selected out 150)

(i)-Technically Focused.

1. Sharma, A., B.R. Locke, P.E. Arce, and W. Finney, "Preliminary Study of Pulsed Corona Discharge for the Degradation of Organic Waste in Aqueous Solutions,'' *Hazardous Waste/Hazardous Materials*, 10, 209 (1993).
2. Joshi, A., B.R. Locke, P.E. Arce, and W. Finney, "Formation of Hydroxyl Radicals, Hydrogen Peroxide, and Aqueous Electrons by Pulsed Streamer Corona Discharge in Aqueous Solution," *J. of Hazardous Materials*, 47 (1), 3, (1995).
3. M. Oyanader and P. Arce, "A New and Simpler Approach for the Solution of Electrostatic Potential Differential Equation," *Journal of Colloid and Interface Science*, 284, 315-322 (2005).
4. Wang, CS, U. Kasavajjuka, and P.E. Arce, "A Discharge Model for Phase Transformation Electrodes: Formulation, Experimental Validation, and Analysis," *J. Phys. Chem. C*; 111(44); 16656 – 16663 (2007).
5. Kasavajjula, U.S., C. Wang and P. E. Arce, "A Discharge Model for LiFePO4 Accounting the Effect of Solid Solution Range and Particle Size," *Journal of the Electrochemical Society*, 1159 (11), A866-A874, (2008).
6. Simhadri, J., H. Stretz, P. E. Arce, and M. Oyanader, "Morphology of Nanocomposite and Template Gels and its Role in the Separation of Biomolecules: A Review," I&*EC Research*, 49(23), 12104-12110, (2010).
7. Camp, J., D. George, M. Wells, and P. E. Arce, "Monitoring Advanced Oxidation of Suwannes River Fulvic Acid", Environmental Chemistry, 7, 225-231, (2010).
8. Thompson, J., H. A. Stretz, and P. E. Arce, "Preliminary Observations of the Role of Material Morphology on Protein-Electrophoretic Transport in Gold Nanocomposite Hydrogels" I&*EC Research*, 49(23), 11866-11877, (2010).
9. Thompson, J., H.A. Stretz, P. E. Arce, H. Gao, H. J. Plohen, J. He, "Effect of Magnetization on the Gel Structure and Protein in Polyacrylamide Hydrogel," *J. of Applied Polymer Science*, 126, 1600-1612, (2012).
10. Oyanader, M., Pedro E. Arce, and James D. Bolden, "Role of Joule Heating in Electro-Assisted Processes: A Boundary Layer Approach for Rectangular Electrodes," *International Journal of Chemical Reactor Engineering,* Vol 11 (2), 815-823 (2013); Published on line on 08/06/2013. **Invited**, Dr. A. E. Cassano Honoring Issue.
11. Oyander, M. and P.E. Arce, "Role of Aspect Ratio and Joule Heating within the Fluid Region Near a Cylindrical Electrode in Electrokinetic Remediation: A Numerical Solution based on the Boundary Layer Model", *International Journal of Chemical Reactor Engineering*, Vol. 11 (2), 687-699, 2013; Published online on 08/25 /2013. **Invited,** Dr. A. E. Cassano Honoring Issue.

12. Koutahzadeh, N., M. R. Esfahani, H. Stretz and P. E. Arce, "Investigation of UV/H2O2 Pretreatment Effects On Humic Acid Fouling On Polysulfone/Titanium Dioxide—And Polysulfone/Multiwall Carbon Nanotube—Nanocomposite Ultrafiltration Membranes," Environmental Progress & Sustainable Energy, 36,27-37, (2017).
13. Allred, N.; Liu, W.Y. and P. E. Arce, "Convective-Diffusive Heat Transfer in Tubes: Role of the Hydrodynamics of Flow on the Feasibility Domain of the Asymptotic Temperature Profiles, Brazilian J. of Chem. Eng., 35, 615-622, (2018).
14. Torrres, C., P. E. Arce, Romero, F. Justel, L. Romero, and Y. Ghorbani, "Joule Heating Effects in Electrokinetic Remediation. Role of Non-Uniform Soil Environments: Temperature Profile Behavior and Hydrodynamics," Environments (MDPI), 5 (8), 92 (24 pages, on line journal), (2018).
15. Pascal, J.; K. R. Medidhi; M. Oyanader; H. Stretz, and P. E. Arce, "Understanding the Collaborative Effects between Polymer Gel Structure and the Applied Electrical Field in Gel Electrophoresis Separation," International Journal of Polymer Science, Hindawi, (15 pages, online journal, Volume 2019, Article ID 6194674, https://doi.org/10.1155/2019/6194674, March 2019).
16. Haris, A., J. R. Sanders, and P. E. Arce. Influence of Pre-electrophoresis on Protein Separations in Polyacrylamide Gels. Journal of Applied Polymer Science. Accepted with minor revisions, December 2019. Revisions provided January 1, 2020. Available on-line January 22, 2020 at: https://onlinelibrary.wiley.com/doi/abs/10.1002/app.48994.
17. Rawal, Sunil, Buer, Sabrina H., Hawkins, Wayne, Sanders, Jonathan Robby and Arce, Pedro E.. "Photocatalytic degradation of acetaminophen from water solutions via thin films part I: preparation, characterization, and analysis of titanium dioxide thin films" *International Journal of Chemical Reactor Engineering*, vol. 20, no. 1, 2022, pp. 97-112. https://doi.org/10.1515/ijcre-2021-0039- Invited-Honoring Issue for Dr. Orlando M. Alfano.
18. Rawal, Sunil, Buer, Sabrina H., Sanders, J. Robby and Arce, Pedro E. "Photocatalytic degradation of acetaminophen in water via ultraviolet light and titanium dioxide thin films part II: chemical and kinetic aspects" *International Journal of Chemical Reactor Engineering,* vol. 20, no. 1, 2022, pp. 113-127. https://doi.org/10.1515/ijcre-2021-0040- Invited-Honoring Issue for Dr. Orlando M. Alfano.

ii) *Engineering Education and Leadership Focused*

1. Arce, P. E. and L. Schreiber, "High Performance Learning Environments, Hi-PeLE," *Journal of Chemical Engineering Education*, 286-291, Fall Issue, (2004).
2. Arce, P. E., M. Oyanader and S. Whitaker, "The Catalytic Pellet: A Rich Learning Environment for Up-Scaling, "Journal *of Chemical Engineering Education*, 41(3), 187-194, Summer Issue, (2007). 2008 Thomas C. Evans Award for the most outstanding paper in Engineering Education - ASEE, Southeastern Section.
3. Pascal, J., C. M. Torres, and P. E. Arce, "The Soccer Ball Model: A Useful Visualization Protocol for Scaling Concepts in Continua," *Journal of Chemical Engineering Education*, 44(2), Spring Issue, (2010).
4. Arce, P. E. with a team of colleagues and students (L. Loggins, A. Arce-Trigatti, J. R. Sanders, J. Pascal, J. Biernacki, M. Geist, and K. Wiant), "The Renaissance Foundry: A Powerful Learning and Thinking System to Develop the 21st Century Da Vinci Engineer," ***Winner of the 2014 Thomas C. Evans Award, ASEE-SE.***
5. Arce, P. E., J. R. Sanders, A. Arce-Trigatti, L. Loggins, J. Biernacki, M. Geist, J. Pascal and K. Wiant, "The Renaissance Foundry", *Critical Conversation Interdisciplinary Journal*, Vol II, 176, 2015. ***Winner of the 2015 Zone II Best Paper, ASEE.(Note 2).***

6. Tijaro-Rojas, R., A. Arce-Trigatti, J. Cupp, J. Pascal and P. E. Arce, "A Systematic and Integrative Sequence Approach (SISA) for Mastering Learning: Anchoring Bloom's Taxonomy to Student Learning," *Education for Chemical Engineers*, 17, 31-43, (2016).
7. Allred, N.; Blanton, S.; Sanders, J R. and P. E. Arce, "Role of Electrokinetics in the Cleaning Efficiency of a Dializer: Toward and Artificial Kidney," Proceeding of the "Electrokinetics Remediation, EREM-2017, International Symposium, Concordia University, Montreal, Canada, August 6-8, 2017.
8. Allred, N., Blanton, S., Sanders., Liu, Y., and P. E. Arce, "Electrokinetics-Hydrodynamics: Bridging the Gap," American Society for Engineering Education (ASEE), Proceeding of the Annual Meeting of the South East Section, Raleigh, NC, March 2018
9. Allred, N., Sanders, R., Liu, Y., and P. Arce, "Integral Spectral Methods Applied to Health Care Engineering: A Student-Focused Pedagogical Approach," American Society for Engineering Education (ASEE), Proceedings of the Annual Meeting of the South East Section, Raleigh, NC, March 2018.
10. Sanders, J. R., A. Arce-Trigatti, and P. E. Arce. "Promoting Student Problem Identification Skills via a Jeopardy-Inspired Course within the Renaissance Foundry". *Education for Chemical Engineers*. 30: 49-59. Available on-line November 9, 2019 at: https://www.sciencedirect.com/journal/education-for-chemical-engineers
11. Arce, P.E., S. Jorgensen, J. R. Sanders, and A. Arce-Trigatti, "Only Two Weeks: The Lived Experiences of Four Engineering Educators Transitioning to Virtual Learning during the 21st Century Pandemic," *the American Education History Journal, Special Edition – Snapshots of History: Portraits of the 21st Century Pandemic,* Shirley Marie McCarther, University of Missouri-Kansas City, Published in 2022.
12. Pedro E. Arce*, Andrea Arce-Trigatti*, Lacy Loggins, J.R. Sanders, Juan Sebastián Guerrero, Gustavo E. Bolaños Barrera, and Mario A. Oyanader. Universes of Learning (UoL) as Creative Educational Experiences: Exploring the TSPACK and Renaissance Foundry Model as Catalysts for Learning Transformations. *New Directions for Teaching and Learning' Special Volume: International Perspectives on University Teaching and Learning,* Volume 2022, Issue 169, Published online, April 26, 2022.
    Note: Table 1a&b at the end (adapted from the contribution on TSPACK published in the Annual Meeting Proceedings of the ASEE-SE, NCSU, April 2019) indicate highlights of the chronological educational efforts implemented at Tennessee Tech University. A list of other initiatives during this period is available from Dr. Arce upon request.

(iii) Other Significant Publications

1. Arce, P. E., A. Cassano, and H. Irazoqui, "The Tubular Reactor with Laminar Flow Regime. An Integral Equation Approach, I. Homogeneous Reaction with Arbitrary Kinetics," *Computer and Chem. Eng.,* 12 (11), 1103 (1988). *Cited in I&EC Research, 44 (14) 2005 as a seminal and mathematically elegant contribution.*
2. Arce, P. E. and D. Ramkrishna, "Pattern Formation in Catalytic Reactors: The Role of Fluid Mixing," *AIChE Journal,* **37** (1), 98 (1991).
3. Locke, B.R. and P. E. Arce, "Applications of Self-Adjoint Operators to Electrophoretic Transport, Enzyme Reactions, and Microwave Heating Problems in Composite Media-I. General Formulation," *Chem. Eng. Sci., **48*** (9) 1675 (1993).
4. Locke, B.R. and P. E. Arce, "Modeling Electrophoretic Transport of Polyelectrolytes in Beds of Non-Porous Particles," *Separations Technology,* **3**, 1-10 (1993).
5. Horner, M., P.E. Arce, and B.R. Locke, "Modeling Arterial Stenosis by Lubrication Approximation and Averaging Methods," *Ind. & Eng. Chem. Res*., 34, 3426, (1995*). Invited contribution for the*

special issue of Ind. & Eng. Chem. Research honoring "Transport Phenomena," a landmark textbook for 35 years, written by R.B. Bird, W.E. Stewart and E.N. Lightfoot, University of Wisconsin-Madison.

6. Sauer, S., B.R. Locke, and P.E. Arce, "Effect of Axial and Orthogonal Applied Electric Fields on Solute Transport in Poiseuille Flows: An Area Averaging Approach," *Ind. & Eng. Chem. Research*, 34, 886 (1995). *First publication to offer an explanation from first principles to the role of orthogonal fields in improving separation in gel electrophoresis.*
7. Arce, P. E., B.R. Locke and I.M.B. Trigatti, "An Integral-Spectral Approach for Reacting Poiseuille Flows," *AIChE Journal*, 42 (1), 23 (1996). *First systematic analysis of the join role of linear operator methods and integral equations in computationally solving complex reacting systems.*
8. Trinh, S., P. E. Arce, and B.R. Locke, "Effective Diffusivity of Point-Like Molecules in Isotropic Porous Media by Monte Carlo Simulations," *Transport in Porous Media*, 38 (3), 241 (2000).
9. Trinh, S., B. R. Locke, and P. E. Arce "Effective Diffusion Tensors of Point-Like Molecules in Anisotropic Media by Monte Carlo Simulation," *Transport in Porous Media,* 47, 279 (2002). *Note: Publication 8 & 9 are first contributions to report the important role of geometry in selecting "domain cells" to follow experimental trends.*
10. Simhadri, J., H. A. Stretz, M. A. Oyanader and P.E. Arce, "Assessing Performance of Irregular Microvoids in Electrophoresis Separation," *I&E Chemistry Research*, 54 (42), 10434-10441 (2015), (Contribution to Professor D. Ramkrisna's Festschrift, **Invited**). *First computational driven analysis to show the important of alignment in affecting transport in electrophoresis separation.*

Patents and Other Intellectual Properties

1. "Methods of Oxidizing Organic Contaminants in Aqueous Mediums Using Corona Induced Reactions." US Patent Application, Serial no. 08/148,785 November 5, 1993; Patent Issued on December 10, 2002: USPTO# 6,491,797 (with A. Sharma, B.R. Locke, and W. Finney). Filing via Florida State University, Tallahassee, FL.
2. "Thermo-responsive Microparticle Composite Hydrogels for Electrophoresis," Full Patent applied for 11/12/2008; Notice of Allowance 2/2012; Issued on 05/2012: USPTO# 8,177,950 (With J. Thompson and H. Stretz). Preliminary licensing agreement with *Promethia Lab*, TTU Start-Up Company, 2013. Filing via Tennessee Technological University, Cookeville, TN.
3. "High Performance Learning Environment, Hi-PeLE™, Trademark filing, 2008. Filing via Tennessee Technological University, Cookeville, TN.
4. Mobile Learning Environment System Infra-Structure, MoLE-SI™, Trademark filing, 2010. Filing via Tennessee Technological University, Cookeville, TN.
5. "Modifying Hydrogels by Applied Electrical Field", Utility Patent Application via Tennessee Technological University, Cookeville, TN, 2020 (With J. R. Sanders and Anfal Haris).

Recent Courses (Selected)

Undergraduate:

- ChE 3121: Transfer Science II (Fluid Mechanics: Experimental Prototype/Lab Sections, Spring 2019; 2020)
- Che 3550: Transfer Science II (Fluid Mechanics) & ChE 3551 (TS-II, Labs), Spring 2022.
- ChE 4990 Undergraduate Research (Spring 2019, Summer 2019; Fall 2019, Spring 2020) & other semesters as needed.

- ChE 4379 Professional Opportunities for Chemical Engineers (Summer 2019, in collaboration with ORNL, Y-12 and Kimberly Clark, Knoxville, TN)

Graduate:

- ChE 7970 Electrokinetics Hydrodynamics (Fall 2016)
- ChE 7970 The Art and Science of Modelling (Spring 2018)
- ChE 7970 Introduction to Heterogeneous Catalysis (Fall 2018)
- ChE 6240, Physics of Transport: Fundamentals and Selected Applications to Chemical, Environmental, and Health Care Engineering Problems, Fall 2019, Fall 2021, Fall 2022.
- ChE 6210 Advanced Kinetics (Spring 2020)
- ChE 6990 Thesis Research (Master Level Students)-Continued
- ChE 7990 Dissertation Research (Doctoral Level Students)-Continued

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References & Notes:

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Cook-Sather, A., "Co-Creating Equitable Teaching and Learning: Structuring Student Voice into Higher Education", Harvard Education Press (22 November 2022, to appear). Acknowledgement: Preview of the book, courtesy by the author.

Note 1: The RFRG at Tennessee Technological University: https://sites.tntech.edu/foundrymodel/

Note 2: The American Society of Engineering Education, Southeast Section, ASEE-SE established this award to honor Professor Thomas C, Evans, The Citadel, Charleston, SC, for his outstanding contribution to education, “The Thomas C. Evans Instructional Paper Award is given to the author or authors of the most outstanding paper pertaining to engineering education.” Dr. Arce is the only candidate to have received the award five times (1994, 2001, 2008, 2014, and 2021).

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TABLE 1a: KEY MILESTONES ILLUSTRATING DR. ARCE'S EDUCATIONAL EFFORTS AND RELATED SPIN-OFFS AT TTU Efforts from the Period 2004-2014- The First Decade: "The Foundation Years"			
Year	**Effort/ Description**	**Comment**	**Highlights**
2004	High Performance Learning Environments- (Hi-PeLE): Teams of Students with Capstone Labs	First analysis indicating a systematization of teams, experiments, and grading	Invited workshops at the ASEE Regional and National Meetings for faculty training
2005	Integration of classroom activities and laboratory work to enhance experiential learning skills	TTU ChE is one of the few programs with extensive labs in critical core courses	Curriculum well recognized among employers with a hands-on approach
2005	The Personalized Class Binder (PCB): A Powerful Tool for Enhancing Act. And Coll. Learn. Environments	An effective tool for notetaking for students and documentation skills	Extensively adopted across curriculum at the TTU ChE Department
2007	Integration of Marketing Plans for the prototype produced in Hi-PeLE- Entrepreneurship aspects incorporated in the student Prototype of Innovative Technology (PIT)	Extensive collaboration with the TTU College of Business: Workshops and other related "immersion" activities for students were conducted	Model led to an entrepreneur certificate at TTU as well as participation in Eagle Works Event where students can "pitch" their PIT
2009	The Composer Style Engineer: Role of Student-centered innovation in the proposal of the PIT	Role of collaboration and teamwork in the concept of PIT: "Connection Dots Style"	Invited Keynote at the ERC-NSF Annual meeting, Washington, DC
2010-2013	Transport Phenomena Sequence at TTU ChE aligned with *Engineering Scaling Concepts*: Scaling is a critical important skill in engineering	Under the coordination by Dr. Biernacki, Dr. Arce guided the integration of scaling in the ChE Department	The use of the Text by Cerro, Higgins ,and Whitaker, adopted- Textbook highlights role of scaling.
2010	MoLE-SI- Integration of mobile devices in helping with STEM computational needs	Vital integration of technology learning spaces- Elimination of ChE "fixed computer labs"	First model of this type in the nation for STEM disciplines- Led to *Tech Everywhere*
2013	The Renaissance Engineering Model adopted at the TTU College of Engineering as part of Strategic Plan	Model recognizes the vital role of critical thinking skills in PIT and teamwork	Learning Acquisition and Learning Transfer are integrated in "holistic-style" engineering professional
2014	The Renaissance Foundry Model formulated & documented. Model is the first integration of six key steps between "Challenge" and PIT	Paradigms of Knowledge Acquisition and Knowledge Transfer bridged by Resources	Received the Thomas C. Evans award from the ASEE-SE for Outstanding Eng. Educ. Contribution

TABLE 1b: KEY MILESTONES ILLUSTRATING DR. ARCE'S EDUCATIONAL EFFORTS AND RELATED SPIN-OFFS AT TTU Efforts from the Period 2015-2027 - The Second Decade: "The Formation Years"			
Year	**Effort/Description**	**Comment**	**Highlights**
2015	The RFM selected as a cornerstone model for the new TTU QEP	Proposal to adapt the RFM to a large class of curricula	Received the Zone II Award for best contribution, ASEE
2016	Steelcase Education grant awarded to build a *Foundry Style Learning Space* at TTU ChE referred to as the Steelcase Active Learning Studio (SALS)	Role of the Learning Spaces recognized and incorporated in the classroom activities	Invited ASEE plenary presentation- part of the recognition of the ASEE to new and promising STEM pedagogical models, Annual ASEE Meeting
2017	Chemical Engineering-Nursing Immersion Course guided by the RFM style fully studied: *Spin-off -Effort* led by Dr. Sanders and Dr. Geist based on the RFM (See 2014)	Course study was part of a doctoral thesis in Education at University of TN-Knoxville (UTK)	Course supported by Venture Well and USA St. Dept.: Cuba trip as immersion. Dr. Sanders and Dr. Geist external members to UTK PhD Committee
2018	Flexible Room for Science Teaching at Algood Middle School, Algood, TN-*Spin-Off Effort* led by Dr. Arce's former Master of Education Student, Mrs. Lacy Loggins	Testing integration of learning spaces into student learning and student feedback on the new room	Received a grant from Putman County School System to support the development and assessment of the new integrated room.
2018	TTU QEP Grant for curriculum modifications awarded- Systematic implementation of the RFM into the TTU ChE Curriculum- Dr. Arce (PI) with the RFRG	New TSPACK model conceived and reported at the ASEE Annual Meeting and proc. article published	First grant of this type awarded to the TTU College of Engineering. Numerous papers pub. in the ASEE proc. and presentation delivered
2019-2020	Applying the RFM to foster service learning in students. Two Grants supported by SERS program from TBR- State of Tennessee	Assisting students from underrepresented minorities in service-learning efforts.	Prototype grants to document effort that led to the NRT-NSF $3M grant at the graduate level for FEW-Nexus
2020-2021	TTU Faculty Research Grant in collaboration with the Department of Curriculum & Instruction	Effort focused on developing a Holistic- Style Coach/Facilit. of Learning	Led to two invited workshops at the ASEE-SE and one at the ASEE National Meeting
2020-2023	Venture Well Foundation Grant for three Chemical Engineering courses with emphasis on Biomimicry concepts	Dr. Arce (PI) with the RFRG- Mindful of Societal Impact focus	Second Grant from Venture Well at TTU-Very competitive process. Helpful grant towards the NRT-NSF proposal
2020	RFM implementation for online experiential learning- One workshop for K-12 level and the other for college level (CL)	Dr. Arce, lead conductor with the RFRG participating, actively	CL workshop, invited by the NSF supported group from WSU, Washington-USA
2022-2027	National Research & Traineeship Program from the National Science Foundation proposal awarded ($3M).	The RFRG with a team of colleagues across four TTU Colleges and three centers	First NRT-NSF proposal awarded to TTU based on key concept fully developed at TTU