Enriching Engineering Education through Active Undergraduate Research

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Abstract

Undergraduate research experience offers many benefits to students pursuing careers in industry or advanced academic degrees. Getting involved in research early enhances technical skills, strengthens problem-solving abilities, and sharpens critical thinking skills. Students gain hands-on experience by applying their knowledge to real industry challenges instead of simply studying theory and practicing its application via class examples. In addition, students develop a problem-solving mindset, learn strategies for managing uncertainty, and acquire experience working both independently and in teams.

Students can select from various research options to develop their ideas. Research projects are available year-round for student involvement. The two main programs are the Undergraduate Research Scholars (URS) program and the Undergraduate Research Experience Program (UREP). Students participating in both programs work under the supervision of a faculty mentor. UREP aims to actively involve students in research, thereby enhancing their technical skills and professional development. This program requires students to write a progress report and a final report, then present their findings publicly. On the other hand, the Quality Enhancement Strategy highlights the URS program's ongoing support for the University's commitment to lifelong learning. This program allows students to write an undergraduate thesis, present their findings publicly, earn honors recognition, and receive a URS medallion as part of their graduation regalia, thereby enriching their education experience beyond traditional classroom settings.

Furthermore, participating in research experience programs helps students develop analytical skills, explore new ideas, and apply academic knowledge in real-world industry settings. Disseminating the results of research through conference presentations and journal publications offers valuable opportunities for professional development and networking. This paper presents a survey of 41 students from previous cohorts of a petroleum Engineering program in a public university to assess the benefit of their participation in noncredit-bearing research projects on their learning and development. The paper also provides examples of research experiments conducted by some members of the surveyed cohorts. The findings show how the students' skills, technical knowledge, and career readiness were greatly improved by the research experience.

Keywords

Industry applications; Problem-solving skills; Professional development; Technical knowledge; Undergraduate research

Introduction

One of the most important pillars of Qatar National Vision 2030 is the Capacity Building initiative [1], which aims to provide the nation with high-quality education and training, particularly for the

younger generation that aspires to assume leadership roles. Since 2003, the university's College of Engineering has offered students the opportunity to pursue four engineering degree programs through its branch campus in Qatar. The faculty at this branch campus has been extremely successful in providing high-quality engineering degree programs. These programs place strong emphasis on the development and instillation of professional skills in their students through a range of opportunities designed and executed by the faculty.

Students interested in pursuing careers in industry or advanced academic degrees might benefit greatly from gaining research expertise throughout their undergraduate studies. By participating in research at an early age, one can improve technical skills, boost problem-solving, and sharpen reasoning and critical thinking [2, 3]. Research work provides early exposure to real-world challenges and workplace-like environments, thereby enhancing students' confidence, communication, collaboration, and project management skills that employers seek in industry settings [4, 5]. Thus, students gain practical experience rather than merely studying theory and practicing it through classroom examples [6]-[11]. In addition, students acquire the ability to think in ways conducive to problem-solving, learn techniques for dealing with uncertainty, and gain experience working both independently and in groups [5]. Some studies suggest that participating in undergraduate research is associated with stronger intentions to pursue graduate education and improved academic performance [12, 13]. To enhance their learning, students in Qatar can choose from a variety of research options. They have the opportunity to participate in research projects during the entire year. Two of the most important programs are the Undergraduate Research Scholars (URS) and the Undergraduate Research Experience Program (UREP).

Motivated undergraduate students have the opportunity to participate in the Undergraduate Research Scholars (URS) Thesis Program, which provides them with the chance to engage in independent research, academic inquiry, and creative work while being mentored by faculty members throughout the process. Through the process of developing a thesis for publication in the OAKTrust Digital Repository, the program offers students the opportunity to make a significant contribution to their profession while gaining vital experience in communication, critical thinking, and project management.

The Undergraduate Research Experience Program (UREP) is the primary project designed by the Qatar National Research Fund (QNRF). The Undergraduate Research Experience Program (UREP) aims to enhance Qatar's research infrastructure by encouraging foundational scientific research at the undergraduate level. Students acquired essential skills for professional advancement through experiential mentor-directed scientific research. The experience students gain through research improves the quality of their education and strengthens their foundation for developing knowledge. By implementing active learning methodologies in undergraduate education, the research program encourages the development of mentorship programs. Not only does the program make it easier for undergraduates to enhance their skills, but it also acknowledges the mentorship that professors provide as a crucial part of a student's academic path.

By methodically linking program goals, student learning outcomes, and assessment techniques, Massi [13] provides a structured evaluation framework for undergraduate research experiences.

This framework is intended to evaluate the program's effectiveness. The research underscores the importance of using multimodal assessment methodologies, including questionnaires, reflections, and performance measures, to capture the cognitive, professional, and affective advances students have made. Faculty and administrators are provided with a useful instrument that allows them to evaluate the program's effectiveness and help in the ongoing advancement of undergraduate research projects through the framework.

The key factors that constitute a good undergraduate research experience in engineering are highlighted in [14]. It emphasizes the development of abilities such as critical thinking, communication, and problem-solving among students engaged in research. In addition, the study emphasizes the importance of successful experiences in teaching students to work independently, the need to build confidence in research assignments, and the need to connect academic concepts to real-world engineering challenges. Finally, it lays the groundwork for evaluating and enhancing undergraduate research programs in engineering education by defining success in terms of student-centered outcomes.

While the literature broadly supports the value of undergraduate research, few studies have examined its impact within petroleum engineering programs in the Gulf region, where institutional structures such as UREP and URS create distinctive research pathways for undergraduates. This paper addresses that gap by presenting survey results from 41 former students of a petroleum engineering program at a branch campus in Qatar, assessing how participation in noncredit-bearing research projects influenced their learning, skill development, and career preparation. The paper also illustrates the scope of student research through selected experimental case studies from recent cohorts.

Undergraduate Research as a Learning Platform

The Undergraduate Research Scholars (URS) program entails a research project conducted over two semesters under the guidance of a faculty mentor. The project involves a public presentation and thesis writing. The students are required to meet the intermediate submission deadlines and to finish their projects within specific dates indicated in the program schedule. Once they complete their submissions, they are added to the Undergraduate Research Scholars collection housed in the Digital Repository Libraries. The application process involves multiple steps, including submission, evaluation, and approval. Undergraduate students with excellent academic standing and at least two semesters left before graduation are eligible to participate in the program. Students who successfully complete the URS program and submit their thesis are awarded the honor of Undergraduate Research Scholar upon graduation. Participation in the URS program counts toward Honors requirements or Capstone experiences. The program schedule for the 2025-2026 cohort of Undergraduate Research Scholars is shown in Table 1.

Table 1. Program schedule for the 2025-2026 cohort of Undergraduate Research Scholars

a. Fall 2025

Date	Description
September 5	Application Deadline
October 21-24	Required Group Check-in 1
November 4	Orientation Module Exam Deadline
November 11-14	Required Group Check-in 2
November 18	Formatting Module Exam Deadline
December 7	Progress Report 1 Deadline

a. Spring 2026

Date	Description
January 20-23	Required Group Check-in 3
January 25	URS Symposium Registration Deadline
February 1	Installment 1 Deadline
February 3	Progress Report 2 Deadline
March 1	Installment 2 Deadline
March 3	Progress Report 3 Deadline
March 17-20	Required Group Check-in 4
April 1	Final Thesis Deadline
April 8	URS Symposium
April 15	Presentation Report Deadline

Research activities can take place throughout the academic year or during the summer. These activities are intended to go beyond those that are related to conventional coursework. Under the guidance of a mentor, the UREP program, supported by the Qatar National Research Fund (QNRF), helps strengthen Qatar's research infrastructure by including students in the process, assisting them in developing their research skills, and contributing to their professional growth. "Learning by Doing" is the mantra that is used to describe the program's goal. Not only does the UREP program support the development of undergraduate students, but it also recognizes the

mentoring our professors provide, which is a crucial component of a student's academic journey. All interested undergraduate students who are enrolled full-time in an undergraduate degree program at an educational institution or university in Qatar at the time the research proposal is submitted are eligible to apply for UREP. Engineering and technology are among the priority areas, and this focus could be generalized across engineering disciplines as part of participation. A wide range of engineering domains can contribute to their expertise, fostering interdisciplinary collaboration, innovation, and more comprehensive solutions to complex challenges.

This section provides a specific illustration of one of the experiments that students have conducted as part of their research in a UREP project. Within the context of this experiment, a comparison is made between the concentrations of corrosion inhibitors across various fluid types, at ambient temperature and pressure, High Temperature and High Pressure (HTHP), and in static versus dynamic corrosion [15]. The students are provided with a laboratory manual that includes information on the history of the experiment, the necessary equipment, essential safety precautions, protocols, and instructions for interpreting the data. Figure 1 shows the fluid types used in the corrosion experiments, while Figure 2 shows the apparatus used for corrosion testing.

Figure 1. Categories of fluids for the experiments

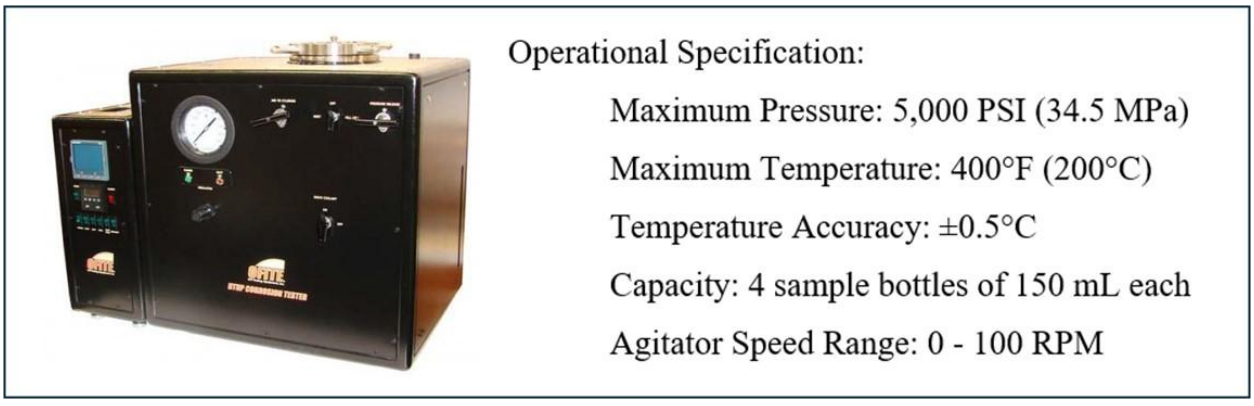

Figure 2. OFITE HTHP corrosion tester

When students participate in experimental activities, they are required to follow the flow protocol depicted in Figure 3. Using potassium chloride (KCl) as an example, Figure 4 illustrates the findings from corrosion plates collected before and after primary and secondary actual testing.

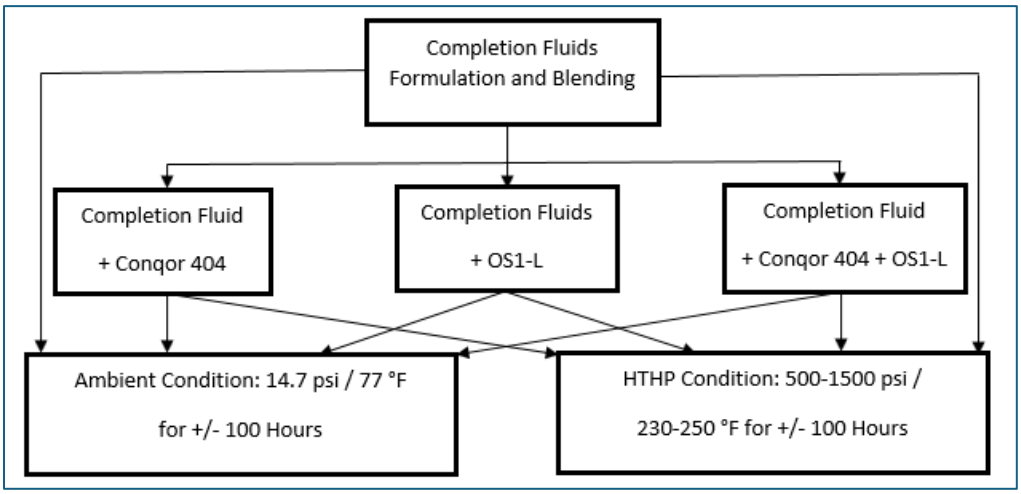

Figure 3. Flow process of the corrosion ring test

a. Before b. After

Figure 4. Corrosion plates in potassium chloride (KCl)

Skill Development through Research Engagement

The student is required to work on multiple tasks throughout the research. The tasks that are listed below serve as an example.

Task 1: Selected students are expected to conduct a relevant literature review. The presentation of appropriate documentation, including published papers, peer-reviewed articles, and even internet editorials, is permitted. A professional writing style, such as SPE, APA, or another format, is required for references.

Task 2: Developing the framework for experimental design. The flow and test series will be precisely established during this step, taking into account the dependent variables used and the conditions encountered during operations, such as elevated temperatures and pressures.

Task 3: As soon as the budget is available, materials and spare items can be purchased. Before the procurement process begins, it is necessary to obtain approvals for certain requirements, such as HSSE and Building Operations clearances.

Task 4: ***Laboratory experiments*** will take the longest to complete this project successfully. Before performing the appropriate tests, it is necessary to thoroughly understand and master all procedures and methodologies. Additionally, it is vital to address all safety-related concerns and complete all training requirements. Manuals and references for standard operating procedures must be accessible at all times, either in print or online.

Task 5: ***Analysis of the results***. In addition to re-stating and reprocessing the data analytics, students are required to produce a standard set of outcomes. This information will be used as raw data to narrow the research's focus. The results of the research will be used to incorporate the design into the material's overall stability.

Task 6: To fulfill the reporting requirements, an interim report must be prepared and delivered during the sixth month. The project's status will be shown in the progress report.

Task 7: As evidence that this project has been finished, the final report will be handed in at the conclusion of the project. Publication of this work will be considered once it has been approved and accepted. All of the students who participated, the principal investigator, and the research mentor will receive authorship.

Students participating in the research project will receive guidance through a comprehensive approach that includes multiple elements. Initially, work expectations and planning will be explicitly delineated, encompassing directives on work habits, experimental timetables, discussion timelines, responsibility distribution, milestones, and criteria for conferring academic credit. Regular meetings will be held to assess progress, provide input, and ensure compliance with study objectives. Secondly, students will be immersed in a research culture, including access to relevant literature, experimental and computational resources, and assistance with recognizing and managing intellectual property (IP) concerns. Instruction will encompass research ethics,

adherence to institutional regulations, study safety protocols, documentation standards, and appropriate reporting techniques. Students will be familiarized with research misconduct policies and urged to methodically document and reflect on their experimental observations. Third, academic advancement will be facilitated by coursework in fluid mechanics, petroleum engineering, and experimental techniques, alongside ongoing assessment of research progress. Students will be granted access to laboratory time, instrumentation, and computational tools to facilitate autonomous research and to engage in discussions with mentors regarding project-related difficulties. Students will be encouraged to participate in academic activities, including attending seminars, engaging with visiting researchers, presenting findings at internal and external gatherings, and applying for internship grants or collaboration opportunities. These events will enhance students' scientific communication abilities, establish professional networks, and prepare them for advanced academic pursuits. Ultimately, guidance will be provided on job prospects and prospective graduate programs, allowing students to explore avenues in petroleum engineering, fluid mechanics, and related research areas.

The research project will equip students with a thorough skill set, encompassing experimental design, operation, data gathering and analysis, computer modeling, and technical reporting. Students will cultivate critical thinking, problem-solving, and decision-making skills while gaining experience in professional research methodologies and collaborative work. The initiative will enhance indigenous research capabilities in engineering, fostering the creation of highly competent graduates equipped to tackle difficulties in industry. The project's results will have broader regional and global effects by advancing understanding of engineering. The proposed activities aim to cultivate a research culture inside the participating institution by involving students in methodical, ethical, and collaborative research methodologies.

The faculty mentor is personally responsible for ensuring the following components are met over the term of the research program:

Standard operating procedures – refer to the method of ensuring that all processes that are followed are maintained in accordance with the highest possible standards. Not only should any fabrication or modification, operating conditions, chemical reactions, and other such things be communicated effectively to all parties involved, but this is especially important for the students.

Safety training – a comprehensive safety training session is required for all students and any operators participating in the research. Additionally, this will determine all the constraints associated with this project.

Research ethics – In order to ensure that all researchers adhere to the greatest level of professionalism, it is imperative that research ethics be addressed. These include respect for different cultures, punctuality in the workplace, the completion of duties, equal involvement, and related matters.

Research compliance – The research culture will be enhanced by ensuring that all documents used are cited appropriately and that legal standards are met. By doing so the protection of intellectual

property rights and the implementation of transformative ideas are guaranteed. In addition, financial resources are used appropriately, all results are evaluated technically, and papers are submitted to journals and conferences.

Professional Growth and Scholarly Dissemination

Undergraduate research is essential for promoting students' professional development by engaging them in authentic academic and technical practices that go beyond conventional classroom education. Active involvement in research projects cultivates advanced cognitive skills in students, including conceptualizing issues, critical analysis, experimental design, data interpretation, and technical communication. These qualities are frequently recognized in the literature as vital outcomes of successful undergraduate research experiences and as fundamental components of professional engineering practice.

Participation in research enhances students' professional identity by positioning them as active contributors to knowledge generation rather than passive users of information. Research indicates that undergraduate researchers show greater enthusiasm, self-efficacy, and confidence in applying engineering principles to practical challenges, thereby strengthening their preparedness for graduate education and professional roles. Research-based learning environments foster transferable skills, including teamwork, ethical reasoning, project management, and communication with diverse stakeholders, all of which are highly valued by employers and accreditation organizations.

Academic dissemination is a fundamental aspect of undergraduate research and marks the culmination of the professional development process. Opportunities to disseminate discoveries through conference papers, posters, journal articles, and technical reports allow students to enhance their written and oral communication skills while becoming acquainted with peer review, academic integrity, and professional standards. Engagement in regional, national, and international conferences enhances students' access to professional networks, disciplinary standards, and emerging research trends, thereby expanding their academic and career outlooks.

Furthermore, participation in peer-reviewed dissemination activities enhances reflective learning and fosters ongoing growth. By addressing reviewer feedback and refining articles or presentations, student researchers gain insight into the iterative process inherent in scholarly work while cultivating resilience and professionalism. These events reflect professional engineering practice, in which design, iteration, quality assurance, and stakeholder feedback are essential to success.

Undergraduate research that deliberately incorporates professional development and intellectual dissemination significantly enhances students' academic maturity and career readiness. When underpinned by systematic mentorship and explicit evaluation procedures, such experiences not only improve student learning outcomes but also strengthen the research culture of engineering schools by integrating scholarship as an essential element of undergraduate education.

Undergraduate students can present their research findings to industry participants at the Qatar Foundation Annual Research Conference [16]. Figure 5 illustrates an example research topic investigated by previous undergraduate students in the petroleum program: the efficacy of nanoparticles in drilling fluids as additives for fluid-loss prevention and wellbore stability enhancement.

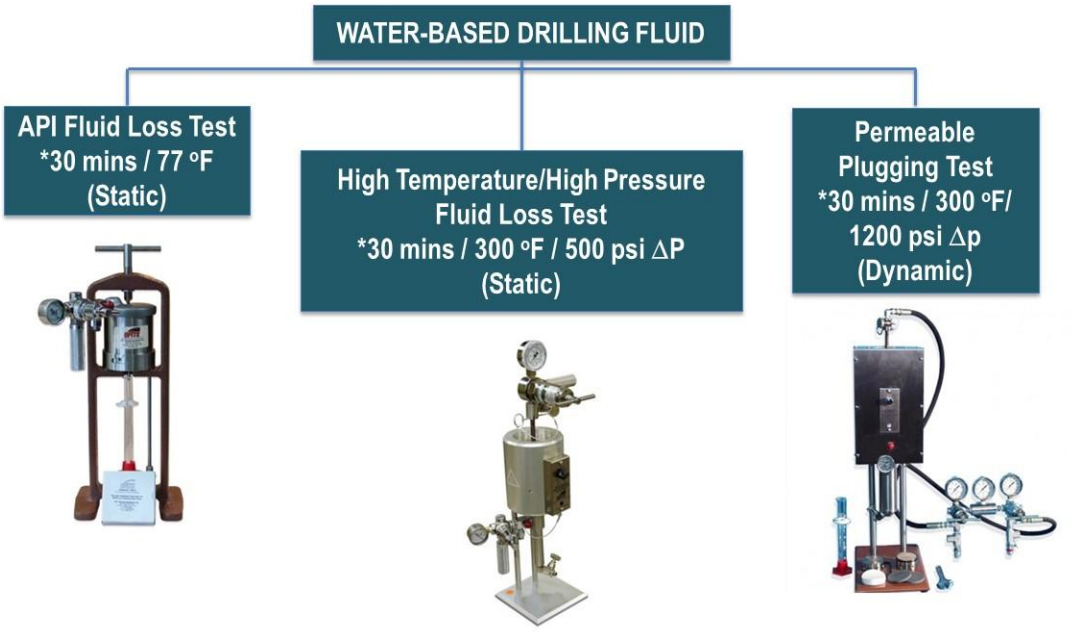

Figure 5. Experimental apparatus for examining the efficacy of nanoparticles in drilling fluids as an addition for fluid loss prevention and wellbore stability enhancement.

As part of undergraduate research in machine learning, a Residual Neural Network was presented, termed ResNet-5, as an effective tool for automated identification of reservoir models using pressure derivative curves. This approach is distinguished by its thorough examination of 20 unique reservoir models, ranging from homogeneous to dual-porosity reservoirs, each defined by 10 specific outer limits. These boundary types include many configurations such as radial flow, circular sealing faults, constant pressures, and others. The team optimized the model's hyperparameters with Bayesian Optimization to get optimal performance. The findings are encouraging, as ResNet-5 attained a remarkable overall classification accuracy of 93.3%. This model's adaptability surpasses the training data, as it effectively identifies signals of varying durations and magnitudes, thereby demonstrating its efficacy. This represents a substantial advancement in reservoir model identification, potentially transforming well-test interpretation methods in the petroleum sector [17]. Figure 6 illustrates that ResNet-5 accurately predicted the newly simulated model. The signal length was 18 hours, whereas the training data was 36 hours.

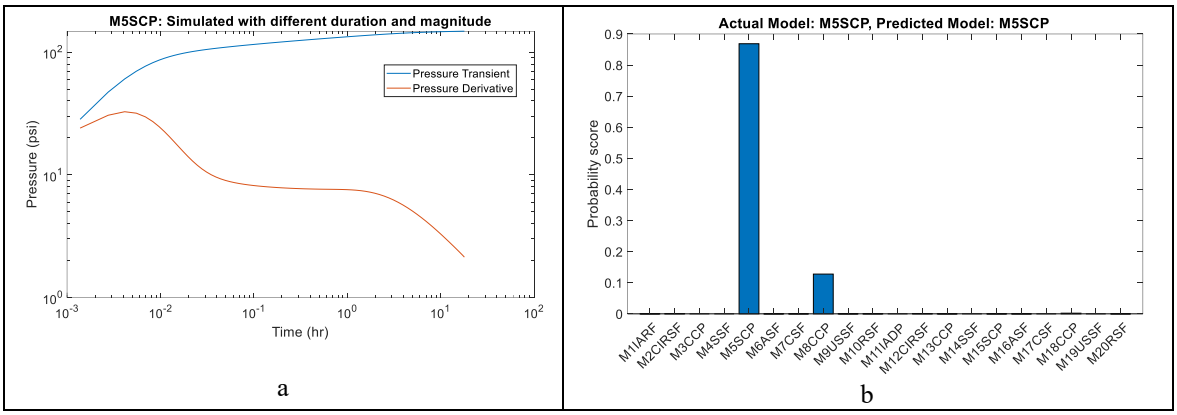

Figure 6. Case study employing varying magnitudes and durations for the signals: a) simulated signals exhibiting diverse durations and magnitudes, and b) probability scores forecasted by the trained ResNet-5 model.

The outcomes of the student research program can be presented at an international conference, such as the Society of Petroleum Engineers (SPE) or the European Association of Geoscientists and Engineers (EAGE). As an example, Figures 7 and 8 show results published by a student [18] at the 81st EAGE Conference & Exhibition.

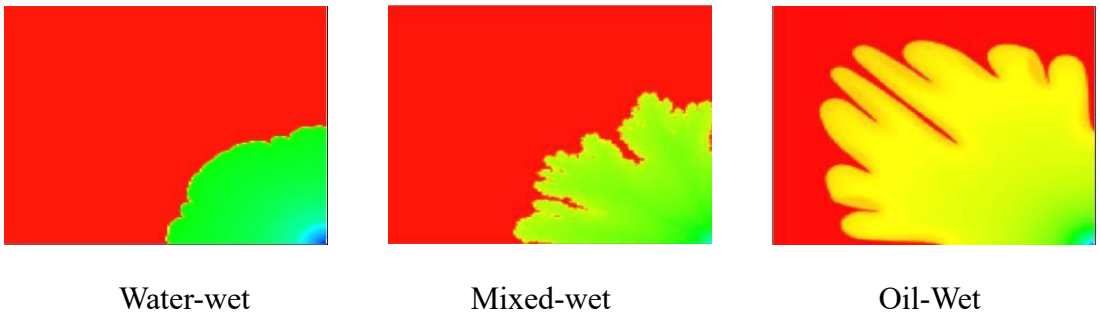

Figure 7. Diagram illustrating simulated viscous fingering in water, oil, and mixed wet conditions within a homogeneous rock system.

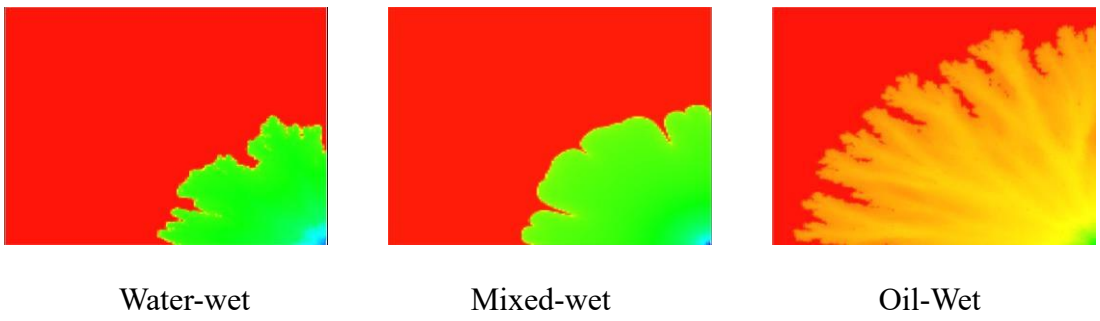

Figure 8. Schematic illustration of simulated viscous fingering in water, oil, and mixed wet. conditions inside a heterogeneous rock system.

Participants of the URS program are required to make a formal presentation at the Undergraduate Research Scholars Symposium and additional campus activities. Students who successfully fulfill the program requirements and submit their thesis are awarded the title of Undergraduate Research

Scholar. This acknowledgment is recorded on their transcript and at graduation ceremonies, and they get distinctive regalia to wear at commencement.

Student Perceptions of Research Benefits

The effects of the research conducted by former students on their workplaces, as well as the effectiveness of undergraduate research among past students, are assessed in this paper. An evaluation of the influence of undergraduate research on students' educational experience was conducted through a survey. Additionally, the demographic information for 41 participants, which are former engineering students is shown in Table 2.

Table 2. Demographic data of the research participants

Classification	Category	Total Response
Gender	Male	27 (65.8%)
	Female	14 (34.2%)
Age	< 25 yrs.	19 (46.3%)
	25 – 30 yrs.	22 (53.7%)
Educational Background	B.Sc.	30 (73.2%)
	M.Sc.	11 (26.8%)
Relevant Work Experience	≥ 2 yrs.	34 (82.9%)
	≥ 4 yrs.	7 (17.1%)

The survey is designed to identify the extent to which undergraduate students' participation in research projects contributes to their overall learning and skill development. From "strongly disagree" to "strongly agree," the survey used seven Likert-scale items (Table 3), each with five response options. These scale levels were coded as follows: "strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5." Table 3 displays the results of calculations based on these codes, including the percentages, the average, and the mode for each item.

Figure 9 demonstrates that former students' comments on the effectiveness of undergraduate research are, on the whole, positive. According to the study's findings, the averages fall between 4 (which means "agree") and 5 (which means "strongly agree"), with the results typically closer to 4. The fact that the mode is between four (which means "agree") and five (which means "strongly agree") further supports the view that the former students believe that incorporating undergraduate research into petroleum engineering education has positive impacts on their learning and abilities, which in turn will benefit them in pursuing employment in industry or advanced academic degrees.

Table 3. The survey items used to test the efficacy of undergraduate research experience on former students with a statistical analysis of the responses for each item.

	Items	Strong Agreement	Agreement	Average	Mode
1	Engaging in undergraduate research has equipped me with the essential tools for academic success in college.	12 (29.3%)	20 (48.2%)	4.07	4
2	Engaging in undergraduate research has enhanced my practical understanding of petroleum engineering principles.	13 (31.7%)	22 (53.7%)	4.17	4
3	Engaging in college research improved my problem-solving abilities.	16 (39.0%)	16 (39.0%)	4.15	5
4	Participation in a collegiate research team enhanced my collaborative skills.	14 (34.2%)	16 (39.0%)	4.07	4
5	Conducting research in a team at college enhanced my communication skills.	18 (43.9%)	15 (36.6%)	4.24	5
6	My collegiate research experience has enhanced my cognitive abilities, including critical, creative, and practical thinking capabilities.	18 (43.9%)	20 (48.8%)	4.37	4
7	All undergraduate students should have research experience to enhance their education.	21 (52.2%)	12 (29.3%)	4.29	5

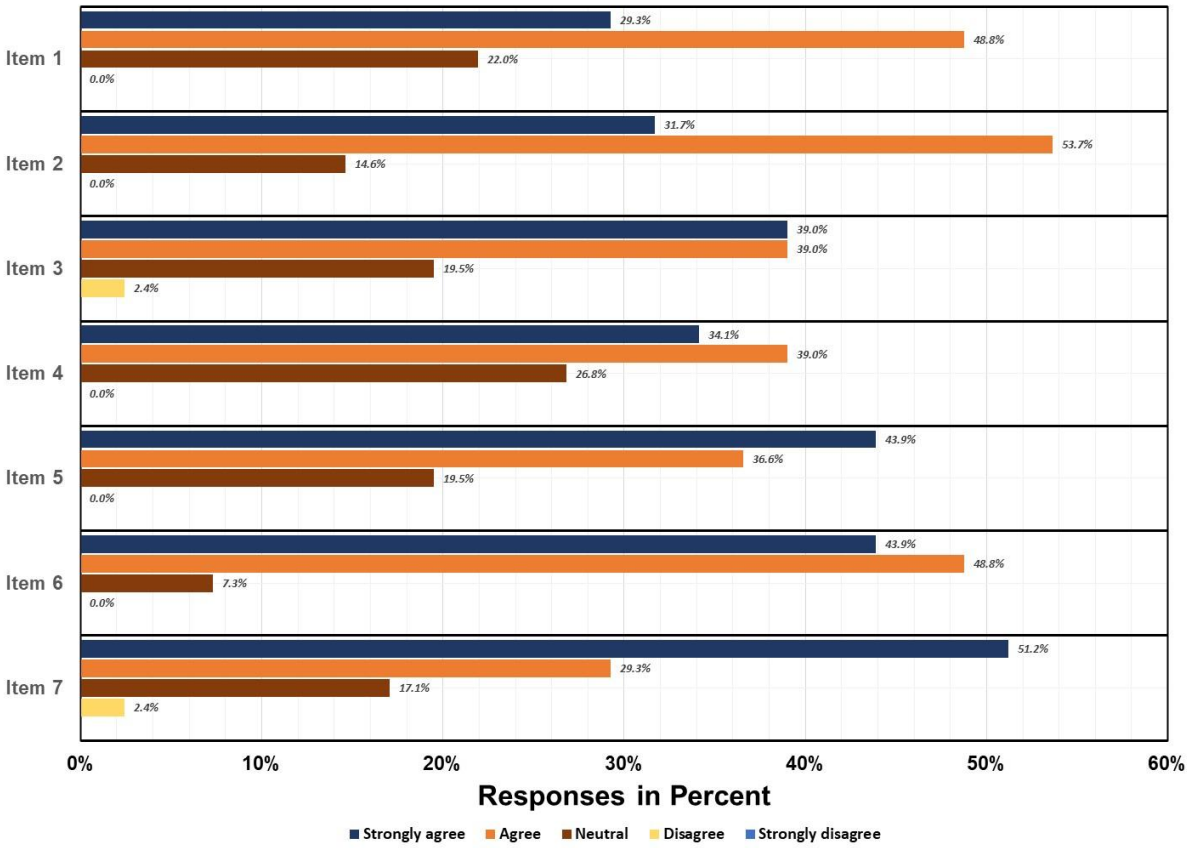

Figure 9. The seven instruments employed to evaluate the effectiveness of undergraduate research experience on alumni, utilizing the complete scale.

To enhance generalizability, the study can be broadened to encompass a quantitative survey of various cohorts across additional campuses, as well as include semi-structured qualitative interviews and focus groups with current students, alumni, and industry supervisors to obtain nuanced insights on how undergraduate research influences professional identity, workplace performance, and preparedness for graduate studies. This mixed-methods architecture will facilitate more robust analytical and transferability assertions while contextualizing the findings across various engineering and institutional environments.

Under the college's Quality Enhancement Strategy (QES), undergraduate research is recognized as a fundamental approach to fostering lifelong learning and transforming students from passive users of information into active producers of knowledge. The institution designates the URS program as a pivotal QES initiative, utilizing undergraduate research to tackle the issue of insufficient early research involvement among engineering students and to foster inquiry habits that promote lifelong learning and ongoing professional development.

Conclusion

The survey results confirm that undergraduate research participation had a meaningful positive impact on the alumni surveyed, with average Likert scores between 4.07 and 4.37 across all seven

items and strong agreement particularly concentrated in communication skills and cognitive development. These findings align with the broader literature [2, 3, 5] while offering specific evidence from a petroleum engineering context in the Gulf region. Beyond self-reported gains, the experimental case studies presented, spanning corrosion inhibitor evaluation, nanoparticle drilling fluids, machine learning for reservoir identification, and viscous fingering simulation, demonstrate that undergraduate researchers in this program engaged with industry-relevant problems at a level of technical depth typically associated with graduate-level work.

This study contributes theoretically to engineering education by transforming the learning process from traditional university lectures to hands-on research that solves real-world industry problems. This experiential learning adds a work-integrated learning dimension to the traditional classroom learning. The findings of this study offer concrete pedagogical directions for improving engineering education. This begins with redesigning courses to make research an integral part of the learning process.

References

1. N. Scharfenort, "Urban development and social change in Qatar: the Qatar National Vision 2030 and the 2022 FIFA World Cup," *Journal of Arabian Studies*, 2(2), pp. 209-230, 2012.
2. D. Lopatto, "Survey of undergraduate research experiences (SURE): First findings." *Cell biology education*, 3(4), 270-277, 2004.
3. S. H. Russell, M. P. Hancock, & J. McCullough, "Benefits of undergraduate research experiences." *Science*, 316(5824), 548-549, 2007.
4. C. Craney, T. McKay, A. Mazzeo, J. Morris, C. Prigodich, & R. De Groot, "Cross-discipline perceptions of the undergraduate research experience." *The Journal of Higher Education*, 82(1), 92-113, 2011.
5. B. Hunter, S. L. Laursen, & E. Seymour, "Becoming a scientist: The role of undergraduate research in students' cognitive, personal, and professional development." *Science education*, 91(1), 36-74, 2007.
6. F. P. Deek, R. Friedman, & H. Kimmel, "Active research experience for undergraduates increases students' motivation and academic performance," in *Proceedings of the 2003 ASEE Annual Conference Proceedings,* ASEE, 2003.
7. W. Zhan & A. Lam, "Benefits of research experience for undergraduate engineering technology students," in Proceedings of the 2011 *ASEE Annual Conference Proceedings,* ASEE, 2011.
8. C. J. Faber et al.," Undergraduate engineering students' perceptions of the nature of research and research skills," *Journal of Engineering Education*, 109(1), 77–98.
9. G. Crebert, M. Bates, B. Bell, C. Partrick, and V. Cragnolini, "Developing Generic Skills at University, During Work Placement and in Employment: Graduates' Perceptions," *Higher Education Research and Development* 23 (2): 147–165, 2004.
10. M. Hernández-de-Menéndez, A. Vallejo Guevara, J.C. Tudón Martínez, R. Morales-Menendez, "Active learning in engineering education. A review of fundamentals, best practices and experiences," *Int. J. Interact. Des. Manuf.* 13, 909–922, 2019.

11. N. Kafadarova, S. Stoyanova-Petrova & D. Stoyanova, “Research-Based Learning in Engineering Education: A Case Study,” *Education Sciences*,” 16(1):59.
12. R. S. Hathaway, B. A. Nagda, & S. R. Gregerman, “The relationship of undergraduate research participation to graduate and professional education pursuit: An empirical study.” *Journal of College Student Development*, 43(5), 614-631, 2002.
13. L. Massi, “Defining an Evaluation Framework for Undergraduate Research Experiences,” in *Proceedings of the 2011 ASEE Annual Conference & Exposition*. ASEE, 2011.
14. J. R. Reisel, “Defining a Successful Undergraduate Research Experience in Engineering,” in *Proceedings of the 2015 ASEE Annual Conference & Exposition*. ASEE, 2015.
15. Retnanto, R. Yrac, A. Shaikh. R. Alagha, F. Alsulaiti & T. Chagouri, “Experimental evaluation of corrosion inhibitors for completion fluids in the petroleum production systems,” *J Petrol Explor Prod Technol* **14**, 331–342, 2024.

A. Retnanto, R. Yrac, A. Shaat, A. Retnanto, L. Abughaush, M. Al Sulaiti, N. Badar, “Evaluation of the viability of nanoparticles in drilling fluids as additive for fluid loss and wellbore stability,” *Petroleum*, Volume 9, Issue 3, Pages 342-351, ISSN 2405-6561, 2023.

A. Retnanto, Md Ferdous Wahid, R. Indico, J. Paderres, M. Malyah, and M. Moussa, "Automatic Recognition of Homogeneous and Heterogeneous Reservoirs Using Deep Learning Technique," Paper presented at the *International Petroleum Technology Conference*, Dhahran, Saudi Arabia, February 2024.

16. T. Abdulhussein, E. Elhafyan, W. Alnoush, N. Alyafei, “Numerical Investigation on the Effect of Wettability and Heterogeneity on Viscous Fingering and Oil Recovery,” Presented at the *81st EAGE Conference & Exhibition*, London, UK, 3-6 June 2019.