The Impact of Internships on Diploma of Chemical Engineering Students: A Case Study of Politeknik Tun Syed Nasir Syed Ismail

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***Abstract*— This study explores the impact of internships on Diploma in Chemical Engineering students at Politeknik Tun Syed Nasir Syed Ismail, with a focus on professional competencies, soft skills, and academic learning. Based on interviews with seven students, findings show that 45% of their development was linked to professional and technical skills, 35% to soft skills like communication and adaptability, and 20% to academic knowledge application. The results highlight the importance of internships in bridging academic learning with industry practice and suggest curriculum improvements, such as integrating IT skills and strengthening communication training.**

Keywords—internships, chemical engineering, soft skills, professional competencies, academic learning, curriculum enhancement.

I. INTRODUCTION

Internships have become a vital component of higher education, offering students the opportunity to acquire practical experience, apply theoretical knowledge, and develop skills relevant to their future careers. They are defined as structured work experiences that are directly related to a student's academic discipline, providing invaluable exposure to real-world industry demands prior to graduation [1].

It is increasingly evident that internships in industrial, nonprofit, or governmental sectors provide mutually beneficial outcomes for both the student and the host organization [2]. Through internships, students gain firsthand experience, foster professional networks, and enhance their employability, while organizations benefit from fresh perspectives and potential future talent.

For students in technical fields like Chemical Engineering, internships offer a unique path to bridge the gap between academic learning and professional practice. As the chemical industry demands skilled professionals who can contribute to industrial processes, research, and development, it is crucial for students to undergo real-world exposure to understand the profession. Internships are critical for Chemical Engineering students as they offer hands-on experience that academic learning alone cannot provide. Additionally, internships help students develop key technical and interpersonal skills, including teamwork, communication, and problem-solving, which are essential for success in the chemical industry [3]. Through real-world exposure, interns can apply their academic knowledge to solve practical industrial challenges, such as contributing to research and development or working on chemical processes in industrial settings.

These internships provide an invaluable bridge between classroom knowledge and practical application, ensuring students are well-equipped for their careers in Chemical Engineering. In the context of this paper, Malaysia's petrochemical sector serves as a major contributor to the nation's economy. Chemical engineers are vital to this industry, overseeing petrochemical production processes and ensuring both safety and environmental compliance. With numerous petrochemical complexes nationwide, the demand for chemical engineers remains consistently high [4]. This highlights the industry's ongoing need for specialised expertise, particularly in chemical engineering.

While internships are considered a vital component of engineering education, there is limited research that specifically evaluates their impact on students enrolled in diploma programs, particularly within the field of Chemical Engineering. **A literature review indicates that studies on the impact of internships from the students' perspective are relatively limited compared to those from the perspectives of employers or educators**. This gap in research is significant because students' experiences and satisfaction with internships can directly influence their academic performance, professional growth, and career readiness.

Furthermore, **understanding the specific challenges and benefits from the students' viewpoint can help educational institutions and employers design more effective internship programs** that align with both academic objectives and industry requirements. Besides that, student feedback during internships is crucial for enhancing the learning experience [5].

Hence, this study aims to address the existing research gap by evaluating the impact of internship experiences on students pursuing a Diploma in Chemical Engineering. The research is guided by two primary objectives, achieved through semi-structured interviews as the main method of data collection, supplemented by secondary data to support the findings. **The first objective is to identify and analyse the effects of internships on these students. The second objective is to propose mechanisms for improving the internship experience**. All data were analysed using content

analysis, with thematic coding employed to explore the impacts of internships on students.

II. METHODOLOGY

This study adopted a **qualitative research** design to explore the impact of internships on students pursuing a Diploma in Chemical Engineering. The qualitative approach allowed for an in-depth understanding of students' experiences, with content analysis as the data analysis method.

Data were collected from both primary and secondary sources. **Primary data were gathered through semi-structured interviews** with students who had completed internships, providing flexibility for open-ended responses and allowing for a detailed exploration of their learning outcomes, skill development, and the influence of internships on their academics. Seven final-year Diploma in Chemical Engineering students were interviewed individually via Google Meet. The students had completed internships at diverse companies spanning various industries.

Secondary data, including journal articles, reports, and reputable websites, supplemented the primary data. The interview questions were developed based on the Creating Internship Learning Outcomes (CILOs) framework from Goucher College, which emphasized key areas such as professional skill development, application of academic knowledge, and personal growth [6]. Questions were designed to explore various independent variables, such as the acquisition of new skills, applying theoretical knowledge in practical settings, and the impact of internships on personal and professional aspirations.

The **data collected were analyzed using content analysis, with thematic coding** used to identify recurring patterns and themes in the interview responses. Secondary data were analyzed in conjunction with the primary data to triangulate the findings, ensuring a comprehensive and well-rounded analysis of the impact of internships on student learning and career development.

III. DISCUSSION AND ANALYSIS

This study involved semi-structured interviews with seven students who had completed internships for 20 weeks, earning 10 credits, each at a different company. Four students interned at companies related to Chemical Engineering, while the remaining three were with companies in other industries such as Mechanical Engineering.

A. Profile of Respondents

Table 1: Profile of Respondents

Respondent	Company	Industry	Department	Location
R1	JF Technology Berhad	Semiconductor Manufacturing	Technical	Selangor
R2	Gloteq Resources	Professional Organizations	Safety and Health	Selangor
R3	Pengurusan Air Pahang (Cawangan Jerantut)	Water Supplies Services	Safety Compliance and Water Quality	Pahang
R4	Anjung Skincare Solutions	Cosmetics	Marketing	Kedah
R5	Guppy Plastic Industries Sdn. Bhd.	Manufacturing	Quality Assurance (QA)	Selangor
R6	Pocket Packaging Sdn. Bhd.	Manufacturing	Operation	Johor
R7	Digital Analytic Structural Integrity Technology (DASIT)	Oil and Gas	Statistical Tube Exchangers Analytic and Reliability (STELLAR)	Perak

In identifying the impact of internship on engineering students, three themes were developed from the data collected: academic learning, professional and technical competencies, and soft skills.

B. Academic Learning

Academic learning refers to applying theoretical knowledge, concepts, and issues learned in the classroom to real-world situations in the workplace [6]. In other words, it involves translating academic knowledge into practical applications, bridging the gap between classroom theory and workplace practice.

The Diploma in Chemical Engineering program at Politeknik Tun Syed Nasir Syed Ismail emphasizes 15 core areas, including Inorganic and Physical Chemistry, Organic Chemistry, Environmental Quality and Pollution Control, Fluid Mechanics and Heat and Mass Transfer. To complete the program, students must acquire 92 credits, which aligns with the Board of Engineers Malaysia (BEM) requirements [7].

Regarding relevant classroom theory applied during internships, many students highlighted the importance of the Occupational Safety and Health for Engineering (OSH) subject. OSH is a multidisciplinary field focused on protecting workers' safety, health, and welfare. One student expressed the desire to gain deeper insights into OSH during their classes, noting its relevance during their internship experience:

"I wish to learn more about OSH." (R5)

Additionally, two students referenced the Environmental Quality and Pollution Control subject, which covers essential knowledge in environmental engineering, including water and wastewater quality, pollution control, waste treatment, environmental management, and related regulations. One student emphasized the value of this subject during her internship, stating:

"The subject is beneficial because I applied the water treatment theory I learned in class to real-world cases. During the internship, everything became clearer through practical experience. I had to collect water samples and conduct jar tests myself." (R3)

Other subjects mentioned by the students included Fluid Mechanics, Organic Chemistry, and Polymer Engineering.

These areas of study provided foundational knowledge used during their internships. Overall, four students reported utilizing 60 to 80 percent of the knowledge gained in class during their internships. However, some students noted a deviation between their academic learning and internship experiences, as they interned at companies in fields such as Cosmetics and Mechanical Engineering, which were not directly aligned with their chemical engineering coursework.

C. Professional and Technical Competencies

In this discussion, professional and technical competencies refer to the ability to design and conduct experiments, utilize discipline-specific techniques and tools, analyze and interpret data, and apply theoretical knowledge acquired at the university to practical work [8, 9, 10, 11, 12].

Several students highlighted the value of **being exposed to industry tools, machinery, and software** often unavailable in academic settings. For instance, one student gained hands-on experience handling complex machinery during their internship. As they explained:

"I gained technical skills in how to operate the machine. At one point, I received an order from my supervisor to visit another branch to analyze the machine before transferring it to a new location. I had to consider multiple criteria, which I had never encountered in college" (R6).

Beyond specialized equipment, students also **developed proficiency in Microsoft Excel**, a tool extensively used in industry but less frequently encountered in academic environments. Many students, recognizing the significance of Excel in professional environments, expressed a desire to have more exposure and training during their time at the polytechnic to prepare them for real-world applications better. As one student noted:

"During polytechnic, I rarely used Microsoft Excel, only when necessary. But during my internship, Excel was used for nearly everything, from entering data to navigating internal systems. I had to learn on my own, like key-in the electric bills for each plant, and I did it until no one supervising me" (R3).

In addition to technical skills, students emphasized the importance of **honing technical writing abilities**, such as report writing, maintaining logbooks, and completing paperwork. These skills, introduced during Project 1 and 2 in semesters four and five, helped students effectively communicate technical information in formats suitable for academic and professional contexts [7]. One student remarked:

"One of the major things that helped me from my time at polytechnic was working on projects. I gained experience with documentation, and during my internship, I had to complete a full set of paperwork. From the first page to the last, I had to cross-check everything, and the formatting skills I learned were incredibly useful" (R2).

This real-world exposure to industry tools, software, and writing processes illustrates the essential role of internships in bridging the gap between academic learning and professional practice.

D. Soft Skills

Soft skills encompass a range of personal attributes, behaviors, and social competencies that empower individuals to communicate effectively, collaborate efficiently, and easily manage conflicts. These skills include leadership, communication, teamwork, creativity, adaptability, self-motivation, problem-solving, and a strong work ethic [13].

Internships are crucial in helping students develop these skills, particularly by enhancing their **communication** with supervisors, colleagues, and clients. Many students reported building strong professional relationships with supervisors and learning the importance of professionalism in various interactions. These experiences allow them to navigate different professional contexts, such as writing reports, participating in meetings, and presenting ideas. For example, one student noted:

"I had the chance to speak with higher-level executives, including managers and supervisors, to identify and resolve issues" (R5).

In addition to communication, students also developed **adaptability skills**. Internships often expose them to diverse workplace cultures, each with its unique norms, expectations, and challenges. This experience requires them to adapt quickly to different environments. One student shared her experience of adjusting to a male-dominated workplace, which required great flexibility and openness. She remarked:

"There are several teams within one unit, and each team has a different dynamic. I needed to adapt to various people and groups. Additionally, there are 140 staff members, with only 10 females working in the office. The team I followed for outside work was all male" (R3).

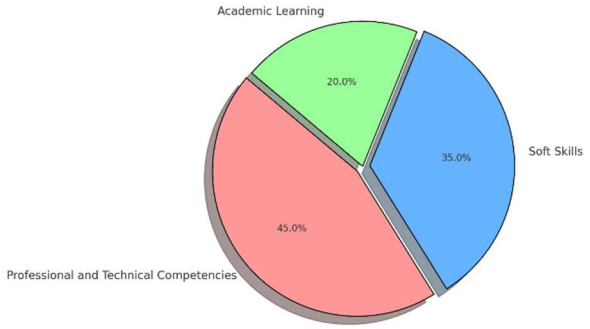
Moreover, internships provide a valuable opportunity for students to build their **professional networks.** Students expand their connections by engaging with supervisors, colleagues, and professionals from various industries, which may lead to future job opportunities. Some students highlighted that their networking skills improved significantly during their internships, particularly through interactions with professionals from different sectors. One student recalled:

"I attended World Semicon Day at WTC, and many companies participated in the event. This exposure broadened my understanding of the industry" (R1).

Internships profoundly impact students' development of soft skills, which are essential for professional success. By engaging with diverse individuals in professional settings, students improve their communication, adaptability, and networking abilities and gain experience in teamwork, conflict resolution, and professionalism. These experiences lay a strong foundation for their future careers.

Based on the discussion and analysis above, the findings can be categorized into three key areas: 45% related to professional and technical competencies, 35% to soft skills, and 20% to academic learning. The pie chart below visually represents each theme's distribution and relative importance.

Figure 1: Distribution of Internship Impacts



E. Recommendation

During the interview process, the respondents suggested a few improvements for better internship experiences. Two of the respondents had shared their expertise on tasks related to computer skills. These respondents feel the institution needs to include IT skills in the curriculum. The most common software being mentioned is Microsoft Excel and the basics of coding is the second most popular skill mentioned. These feedbacks show that IT skills are crucial in the industry and students should be well-equipped with them. The institution needs to take responsibility by offering courses related to these skills or by preparing platforms for students to learn the skills. Other respondents also suggested that more emphasize should be given to knowledge related to occupational safety and health. This respondent whose job scopes are related to quality assurance mentioned that knowledge is very important in the industry because all processes require good safety practices. Thus, the institution shall instil the elements of safety practices in all related subjects and ensure that the information is always updated to ensure that the students are well equipped with relevant and latest knowledge.

Besides, the respondents also shared their struggles in finding internship placements because most of the companies prefer students with a bachelor degree background and longer internship periods. Due to this reason, a suggestion was made for the institution to innovate a system showing the list of companies that the previous students had internships with. Although it is not mentioned during the interview, the institution may also include other information in the system, such as feedback from previous interns on allowances, job descriptions and work environments. This information will be very important for the students considering that one of the respondents mentioned that the allowance received was lower than the recommended allowance by the government which is RM800 and the job scopes were completely different from the chemical engineering course [14]. Since some of the respondents' job scopes are not related to chemical engineering, the information on the system can also benefit students from other engineering disciplines who might face the same struggle in finding internship placement.

One of the soft skills mentioned by the respondent was communication skills. The respondent suggested that the institution should train its students with good communication skills to excel in the industry. To improve this skill, the efforts go both ways where the institution can organize activities to improve the students' communication skills and the students should be more proactive in joining the activities organized. This skill is important because engineering graduate with better soft skills including communication skill will be more competitive in the job market [15].

IV. CONCLUSION

This study underscores the pivotal role of internships in connecting academic knowledge with industry practice for Diploma in Chemical Engineering students. Internships enhance students' professional, technical, and soft skills, while enabling them to apply classroom knowledge in real-world contexts. Additionally, the findings suggest the need for curriculum improvements, particularly in IT proficiency, communication, and occupational safety practices. By addressing these areas and implementing a structured internship placement system, academic programs can better align with industry demands and further support students' transition into their professional careers.

REFERENCES

[1] J. Pan *et al.*, "The interplay of proactive personality and internship quality in Chinese university graduates' job search success: The role of career adaptability," *Journal of Vocational Behavior*, vol. 109, pp. 14–26, Sep. 2018, doi: 10.1016/j.jvb.2018.09.003.

[2] "Curriculum guidelines for Undergraduate programs in Statistical Science," *Default*. https://www.amstat.org/education/curriculum-guidelines-for-undergraduate-programs-in-statistical-science-

[3] "Professional Skills & Competencies - American Chemical Society," *American Chemical Society*. https://www.acs.org/education/policies/acs-approval-program/guidelines/professional-skills.html

[4] "Top 7 Engineering Job Positions in Malaysia with High Demand." https://www.ajobthing.com/resources/recruiter-advice/top-7-engineering-job-positions-in-malaysia-with-high-demand

[5] M. T. Hora, M. Wolfgram, and S. Thompson, "What do we know about the impact of internships on student outcomes?," Center for Research on College Workforce Transition, 2017.

[6] "Career Education Office (CEO) | Goucher College," *Goucher College*. https://www.goucher.edu/career-education-office/

[7] Politeknik Tun Syed Nasir Syed Ismail, BUKU PANDUAN PROGRAM JABATAN KEJURUTERAAN PETROKIMIA (JKPK). 2020.

[8] Y. N. A. Yeung, C. C. Lai, W. F. Ho, A. Sivan, L. Gow, and J. Ledesma, "Attitudes towards industrial training in the BEng. course in building services engineering at Hong Kong Polytechnic," *Studies in Higher Education*, vol. 18, no. 2, pp. 205–226, Jan. 1993, doi: 10.1080/03075079312331382379.

[9] G. Lock, K. Bullock, V. Gould, and M. Hejmadi, "Exploring the industrial placement experience for mechanical engineering undergraduates," *Engineering Education*, vol. 4, no. 1, pp. 42–51, Jun. 2009, doi: 10.11120/ened.2009.04010042.

[10] S. K. Najid *et al.*, "Perception of Faculty Engineering and Built Environment's Students towards the Benefit of Industrial Training," *Procedia - Social and Behavioral Sciences*, vol. 60, pp. 157–162, Oct. 2012, doi: 10.1016/j.sbspro.2012.09.362.

[11] C. K. Parsons, E. Caylor, and H. S. Simmons, "Cooperative Education Work Assignments: The role of organizational and individual factors in enhancing ABET Competencies and Co-OP Workplace Well-Being," *Journal of Engineering Education*, vol. 94, no. 3, pp. 309–318, Jul. 2005, doi: 10.1002/j.2168-9830.2005.tb00855.x.

[12] S. Renganathan, Z. A. B. A. Karim, and C. S. Li, “Students’ perception of industrial internship programme,” *Education + Training*, vol. 54, no. 2/3, pp. 180–191, Apr. 2012, doi: 10.1108/00400911211210288.

[13] A. Kumar, P. N. Singh, S. N. Ansari, and S. Pandey, “Importance of soft skills and its improving factors,” *World Journal of English Language*, vol. 12, no. 3, p. 220, Apr. 2022, doi: 10.5430/wjel.v12n3p220.

[14] “Kerajaan, GLC bayar elaun minimum pelatih industri RM800 - Anwar,” *Berita Harian*, Jul. 14, 2023. [Online]. Available: https://www.bharian.com.my/berita/nasional/2023/07/1126560/kerajaan-glc-bayar-elaun-minimum-pelatih-industri-rm800-anwar

[15] S. Sahudin, N. Shuib, N. C. Maideen, and R. Wahab, "Literature review on the factors affecting employability of engineering graduates," pp. 13-22, 2022.