Does the French Engineering Education Approach to Internships Work in China? Perception of Chinese Students Enrolled in a Sino-French Engineering Program in China

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Abstract

Work-Integrated Learning (WIL) has gained global attention as a means of enhancing graduates' employability and learning outcomes. In China, WIL has been identified as a national strategy to elevate the quality of engineering education. This study investigates the effectiveness of the French engineering education model of WIL internships in the unique cultural and educational landscape of China by examining the perceptions of Chinese students enrolled in a Sino-French engineering program. Grounded in views of situated learning, the research explores the role of internships in students' learning and professional development, as well as the facilitating and impeding factors.

Nineteen final-year students participated in in-depth semi-structured interviews, providing insights into their internship experiences. The findings reveal that internships contribute to competence development and facilitate the transition from higher education to the world of work. However, students face challenges in balancing coursework, thesis, and internships, navigating relationships with university supervisors and industry mentors, and reconciling the dichotomy of generalization and specialization. The study emphasizes the importance of considering the sociocultural context in which WIL is embedded and highlights the agency exercised by students in shaping their perceptions of the engineer's role, qualifications, and career paths in the community of practice.

This research contributes to the international discourse on WIL by providing insights into the experiences of Chinese students in a Sino-French engineering program, offering valuable implications for the implementation and enhancement of WIL in diverse cultural and educational contexts.

Keywords: Work-Integrated Learning, internship, Chinese engineering education, French engineering education, situated learning, community of practice

Introduction

The emphasis on Work-Integrated Learning (WIL) has gained global traction as a means to enhance the learning outcomes and employability of graduates by providing them with real-world experiences and industry-relevant skills (Jackson & Bridgstock, 2021; Rouvrais et al., 2020). In China, WIL has been identified in recent years as a national strategy to elevate the quality of education (State Council, 2017) and especially to train ‘outstanding engineers’ (Lin, 2023). However, in an engineering education context that has historically lacked industry participation, universities are finding it challenging to implement WIL, particularly in the form of internships where students gain hands-on experience in a work setting. Even in

situations where internships have been implemented, research has revealed that they are often ‘just a formality and going through the motions’ (Du et al., 2017).

WIL in engineering education is not new, and well-established practices, such as sandwich degree offerings in the UK, cooperative education in North America, and WIL in Australian universities under the National Strategy for WIL, offer valuable references (Edwards et al., 2015; Luk & Chan, 2020). There has been significant discussion among both engineering education researchers and practitioners on learning experiences from these well-established models (Lin & Geng, 2019; Cai et al., 2019; Qie et al., 2019). In the French engineering education model, WIL is an integral part of the curriculum, with internships in industry fully integrated into the curriculum. A number of studies by Chinese researchers have analyzed the French model and recommended its implementation in China (Yu et al., 2013; Liu, 2011). In fact, such ideas have already been put into practice. Since the creation of the first Sino-French joint engineering school in China in 2005, 14 such joint schools have been established offering French engineering education programs in China conferring engineering diplomas accredited by the French Commission des titres d'ingénieurs (CTI) (Embassy of France in China, 2023).

While substantial effort has been made to implement French engineering education programs in China, with WIL internships being an important component, there has been very little empirical research investigating the effectiveness of the practice. WIL occurs within the real-world context of work, deeply embedded in local sociocultural dynamics. The WIL in French engineering education is traditionally adapted to the societal and economic contexts of France, where both the profile of the engineer and the relationship between academia and industry are different from that of China (Remaud et al., 2010). Whether a model of practical training that works in one sociocultural and educational context can thrive in another remains to be ascertained. Furthermore, there is a notable scarcity of empirical studies on the effectiveness of WIL in transnational education (TNE) in general (Bilsland et al., 2019), emphasizing the need for deeper exploration of WIL within diverse cultural and educational contexts.

In addition, the existing body of practice and research on WIL has predominantly been framed within the discussion of employability, with both theoretical and policy discourses dominated by the human capital approach, which portrays the learner as deficient and in need of passive adaptation to meet the requirements of the job market (Jackson, 2017; Marginson, 2023; Robson, 2023). There is a notable dearth of research that explores WIL from the perspective of the learner and seeks to understand their learning and self-formation within the sociocultural context in which they are situated as they engage with the world of work.

This research aims to address these gaps by examining the perceptions of a group of Chinese students enrolled in a Sino-French engineering program (SFEP) in China, shedding light on the role of WIL in their learning and professional development within the unique cultural and educational landscape of China. Specifically the research questions are: How do students perceive the value of their WIL internship experience in terms of the role it plays in their learning to become an engineer? What are the factors in the overall curriculum - both work-

related and academic-related - that facilitate or inhibit their WIL as perceived by the students? What impact do WIL internships have on students' professional identity as they participate in the local engineering community of practice?

About SFEP

SFEP is a Sino-French engineering school established by a consortium of 4 French engineering schools in collaboration with a leading research university in China. The school adopts the French engineering education model while integrating some academic features of the host Chinese university. The mission of the school is to educate top generalist engineers with a global vision, systematic thinking, and innovation capabilities. Each year, SFEP admits 120 students through the Chinese university entrance examination, the performance of the students typically ranking in the top 0.3% nationwide.

The students undertake an integrated Baccalaureate-Master's program spanning 6.5 years, comprising a preparatory cycle (3 years) and an engineering cycle (3.5 years) aligned with the French engineering system. This is equivalent to 4 years of bachelor's and 2.5 years of master's studies in the Chinese higher education system. During the undergraduate (preparatory) stage, students pursue courses in basic sciences and humanities, with intensive training in mathematics and physics, reflecting a typical feature of French engineering education (Lema ître, 2017). In the master's (engineering) stage, students engage in general and interdisciplinary engineering studies and specialize in an area of study in which they will complete a master's thesis.

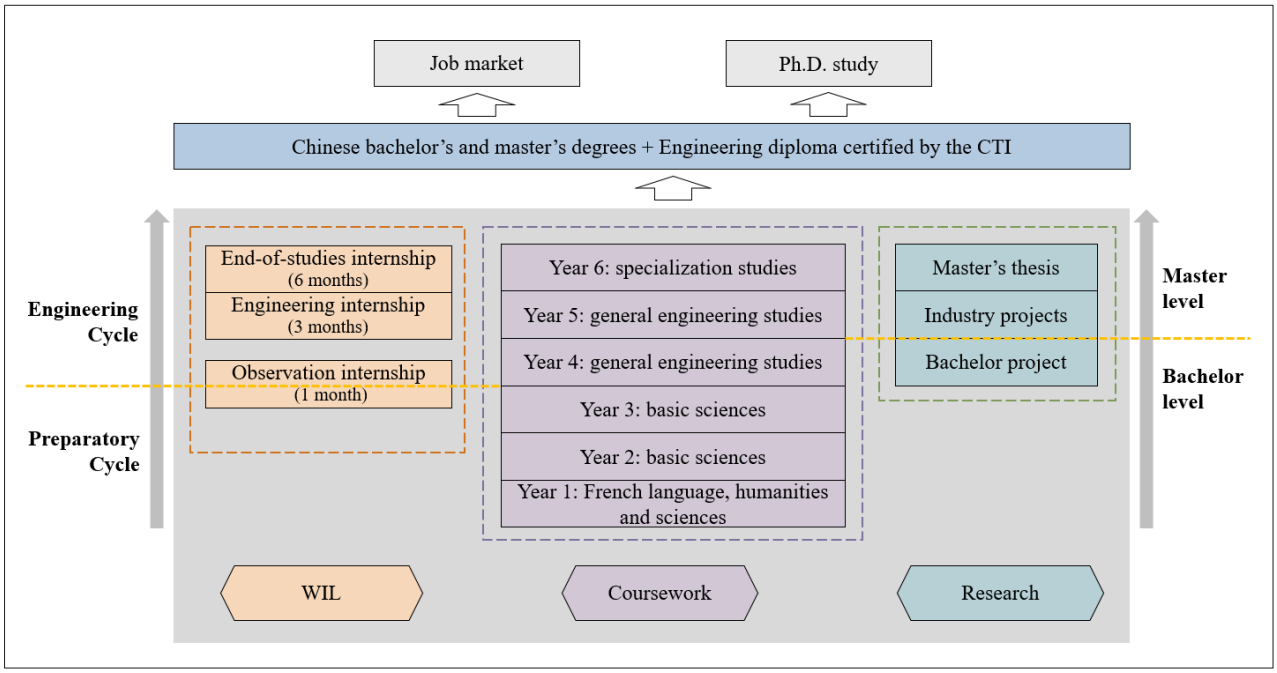

Figure 1. SFEP curriculum structure

The WIL program at SFEP includes three internships designed to develop professional competences in a progressive manner. These include a one-month 'observation internship' at

the end of the third year, providing students with exposure to basic tasks and an initial understanding of industry operations and production processes within companies. This is followed by a three-month ‘engineering internship’ at the end of the fifth year, enabling students to gain deeper insights into the engineering profession through their own practices, reflections, and analyses. Finally, in the sixth year, students undertake a six-month ‘end-of-studies internship’ in industry to solve real engineering problems.

Graduates who meet the requirements are awarded Chinese bachelor's and master's degrees, as well as engineering diplomas certified by the CTI. Figure 1 illustrates the curriculum structure of SFEP. SFEP’s approach to internships aligns with WIL in French engineering education (CTI, 2023; Rouvrais et al., 2020), which is notably distinct from the prevailing Chinese model where practical experience, although required to varying extents, is often limited to company visits (Du et al., 2017).

Literature review

A significant amount of research has been done on the impact of WIL internships on employability and student development. WIL is considered instrumental in enhancing graduate employability by improving a range of employability skills (Jackson & Dean, 2023; Patrick et al., 2008), providing opportunities to practice and refine skills in a real world setting (Jackson, 2015). Work placement enhances career clarification for students (Zegwaard & Coll, 2011), facilitates graduate employment transitions (Bilsland et al., 2019) and has been shown to have a positive relationship with employment outcome (Jackson, 2018; Jackson & Rowe, 2023; Silva et al., 2018). WIL is widely perceived as providing learning and career benefits to engineering students (Rouvrais et al., 2020; Tennant et al., 2018). Studies have also been done on the impact of WIL on professional identity development, extending beyond the traditional focus on employability. Eames and Coll (2006) and Zegwaard and Coll (2011) contend the enculturation process into a community of practice during WIL experiences allows students to develop a deep understanding of their identity within the workplace and transition from student to practitioner. Jackson (2017) found that work placements are significant for shaping students' pre-professional identity. Research has also shown that participation in WIL provides opportunities for students to engage in transformative learning that shape professional identity formation (Trede, 2012). Both facilitating and impeding factors in implementing WIL have been studied (Choy & Delahaye, 2011; Jackson, 2015; Patrick et al., 2008).

Despite the amount of work carried out on the effect of WIL internships, there has been scarce research on WIL internships implemented in a TNE situation. One such rare study was carried out by Bilsland et al. (2019) on a group of business undergraduate alumni on the value of internship electives in a TNE project in Vietnam. WIL of French engineering education has been studied in the French cultural context (Remaud et al., 2010; Rouvrais et al., 2020), but empirical research on the effect of such programs remain to be addressed.

Theoretical perspective

The theoretical framework of this study is grounded in Lave and Wenger's (1991) model of situated learning, which presents a social and situated view of learning, emphasizing participation in the social world rather than focusing solely on the individual learner's cognitive processes. According to Lave and Wenger, learning occurs through legitimate peripheral participation in a community of practice (CoP), where the newcomer engages with a practicing expert, gradually internalizing workplace norms through mediated action and situated learning. Wenger (1998) further identifies four components of learning: meaning, practice, community, and identity. These components respectively represent learning as experience, learning as doing, learning as belonging, and learning as becoming.

Previous research has employed the framework of situated learning to conceptualize WIL (Billett, 1994; Eames & Bell, 2005; Eames & Cates, 2011). Eames and Coll (2006) contend that in order to comprehend cooperative education as an educational approach, it is crucial to recognize the significance of contextual elements, particularly sociological factors. This theoretical perspective is highly relevant to this study as it aims to investigate how sociocultural contexts within the local Chinese engineering CoP influence students' learning experiences and professional identity development, specifically their progression towards becoming engineers through experiential learning. WIL internships provide students with opportunities to learn through enculturation into the CoP and its norms, and to understand it within the context of their sociocultural histories, including their previous experiences and identities in other CoPs (Eames & Coll, 2006). This aspect is particularly pertinent to this study as it also aims to explore the interaction between students' prior academic training based on a French engineering education model and their learning experiences and identity formation within the Chinese workplace setting. It not only assists students in comprehending the CoP but also facilitates their understanding of the engineering profession, identity development, and the decision-making regarding their fit within the CoP and their career paths (Eames & Bell, 2005).

Methodology

Participants

The study participants comprised 19 final-year students enrolled in the integrated Baccalaureate-Master's program at SFEP, which spans 6.5 years. The selection of research participants was conducted from a total of 80 final-year students who had fulfilled all required internships in their curriculum. A research invitation was extended to all 80 students, 19 of whom responded and agreed to participate in the research. The participants, aged between 24 to 26, included 4 females and 15 males. Each participant had completed a minimum of two internships as part of the program, with one internship lasting at least 4 weeks and the other lasting a minimum of 6 months. In accordance with program requirements, students normally need to attend 3 internships but due to interruptions by COVID-19 the three-month internship was made optional. As a result, 14 students completed 2 internships each and 5 students completed 3 internships. With the exception of 4 students

who completed at least one internship in France, all other internships took place in China. The internships were undertaken in various types of companies, including private companies, state-owned enterprises, and multinational companies operating in China across technology, manufacturing, finance, services, and energy sectors, encompassing small and medium-sized to large-scale enterprises. 3 out of the 19 students completed one of their internships in China at multinational companies headquartered in France, while the remaining internships were completed in Chinese companies. 4 out of 19 plan to seek further studies whereas the others have found employment or are in the finalizing stage. The sample provides a reasonable representation of the diversity within the program's overall population, including gender distribution, internship experiences and career paths, with the aim of capturing a broad range of perspectives and experiences related to WIL within the program. Table 1 presents detailed information about the participants.

Table 1. Participant information

Participant	Gender	Internship experience	Field of study
S1	male	1 month in local company 6 months in local company	artificial intelligence
S2	male	1 month in engineering school in France 1 month in local company 6 months in local company	mechanical engineering
S3	male	1 month in local company 6 months in local company	electronic and information engineering
S4	male	1 month in local company 6 months in local company	electronic and information engineering
S5	male	1 month in local company 6 months in local company	industrial engineering
S6	female	1 month in local company 6 months in local company	electronic and information engineering
S7	male	1 month in French company in France 5 months in French company in France 6 months in local company	software engineering
S8	male	1 month in local company 1 year in local company	mechanical engineering
S9	male	1 month in local company 6 months in local company	electronic and information engineering
S10	female	3 months in local company 6 months in local company 9 months in local company	artificial intelligence
S11	male	10 months in local company 6 months in local company	artificial intelligence
S12	female	1 month in local company 1 year in local company	transportation engineering
S13	female	1 month in France in a lab 6 months in multinational company in China	software engineering
S14	male	1 month in local company 1 year in local company	artificial intelligence
S15	male	1 month in local company 6 months in multinational company in China 6 months in local company	computer science and engineering
S16	male	1 month in local company 10 months in local company	artificial intelligence
S17	male	1 month in local company	artificial intelligence

		3 months in multinational company in China 6 months in local company	
S18	male	1 month in local company 5 months in a government agency in France 6 months in local company	systems engineering
S19	female	1 month in local company 6 months in local company	computer science and engineering

Data collection and analysis

This research employed a qualitative approach to investigate students' perceptions of their internship experiences. In-depth semi-structured interviews were conducted with all 19 students to ensure a comprehensive exploration of the research questions and to capture the complexity of the students' perceptions within the specific socio-cultural and educational contexts under investigation. Each interview lasted between 40 to 60 minutes and was transcribed verbatim for analysis. Thematic analysis was used to analyze the data collected from the interviews, aiming to identify recurring themes and patterns in the students' perceptions of their internship experience. This approach facilitated a comprehensive exploration of the lived experiences of the students and their sense-making regarding WIL within the context of the program.

Findings

Students' perception of the value of their WIL internship experience

The vast majority of the interviewees regard internships as playing a positive role in their learning and conducive in the process of them becoming an engineer. The benefits include both learning outcomes in terms of competence development and preparation for transitioning into the engineering profession, although internships were not viewed as useful in terms of supporting those who seek further Ph.D studies.

Development of a broad set of competencies

As with previous studies, students largely acknowledged the benefits of WIL as providing opportunities to practice and develop skills in a real world setting (Coll et al., 2009) and engage with professional CoP to gain a clearer understanding of the roles, expectations and outcomes of their profession (Jackson, 2015)

Generic competences. Students have overwhelmingly reported gains in generic competences such as interpersonal skills, communication and negotiation skills, teamwork, problem solving, flexibility, intercultural competencies, critical thinking and the ability to analyze and solve complex engineering problems. Although training in these skills was part of their curriculum, some reported they did not fully appreciate the value of these 'soft skills' courses, often deeming them marginal, or more often than not, lacking in the Chinese engineering education curriculum(Yuan & Lei, 2023). Internship experience has helped students to make sense of the importance of generic competencies, as indicated by one student who reflected

on how he came to realize the importance of communication:

> Communication was one of the things I learned. My mentor said something that left me with a very deep impression. He said that no matter whether you're providing a service or a product, you're essentially communicating with people. You can't use the excuse that it's a technical job to deny its interpersonal attributes, because your products will always end up being used by a person. (S7)

Many students have reported a heightened sense of social responsibility as engineers. One student expressed that 'the training of engineers is the training of a person' (S2). They have become significantly more attuned to the societal aspects of engineering and the importance of integrating social and ethical dimensions into their work. Human-centered issues, such as ecology, environmental protection, and life cycle considerations, now occupy a much more prominent place in their consciousness.

Linking theory with practice. WIL represents not only a combination of work experience with academic learning but also an integration of learning from both domains (Zegwaard & Coll, 2011). WIL internships offer students a foundation to expand their discipline knowledge and utilize skills with guidance from a supervisor and peers (Patrick et al., 2008) In the French engineering curriculum, students delve deeply into mathematics and physics, a characteristic not commonly found in other systems (Chatzis, 2010; Lema ître, 2017) The rigorous nature of these courses often posed challenges for students. However, through internships, students came to realize that their scientific studies had laid a strong foundation for their training, providing them with a broad base from which to explore various fields of study. 'It was a training of the mind and the ability to learn' (S9). They particularly valued the opportunity to exercise independent thinking and learning abilities, which stemmed from their strong scientific training, enabling them to master new tools and successfully complete assigned projects. Students expressed a sense of heightened theoretical knowledge and an expanded breadth of understanding.

Knowledge of the industry and the workplace

Internships play a crucial role in helping students develop a comprehensive understanding of the industry, providing them with insights into the work environment, application scenarios, and industry operations. By immersing students in the industrial context, internships offer a firsthand view of the entire industrial process, from prototype to marketing, allowing them to observe the full product life cycle and comprehend the role of engineers within it. This experience provides an opportunity for immersive, project-based learning that may not be fully replicated within the university curriculum.

> I learnt that everything needs be adapted to the overall context, which is really something I didn't think about before. I had simply thought you just need to do your job, but the context was missing. Solving engineering problems is more than just an understanding of technical details. You have to consider what kind of role those technical details play for the entire product or the whole service, and then decide how to balance different priorities. Everyone needs to have a context awareness. Simply finishing your own job is not enough. (S7)

Furthermore, students gained a deeper understanding of the workplace, including aspects such as work environment, corporate cultures, job responsibilities, workload, as well as remuneration and welfare.

Development of professional and academic networks

The majority of the interviewees emphasized the significance of social interactions during their internships. Many developed close and enduring relationships with mentors and colleagues. Students also reported establishing positive connections with superiors, government officials, and customers. In two instances, internships at tech startup companies brought them into contact with leading researchers in their respective fields, thereby expanding their research networks.

Career clarification and planning

WIL provides valuable insights into career options and facilitates career clarification for students through their legitimate peripheral participation in a CoP (Zegwaard & Coll, 2011). Internships offered students the opportunity to gain firsthand experience in various work environments, allowing them to explore different career paths. As one student expressed, 'they offer opportunities for trial and error' (S9). The majority of interviewees strongly advocate making full use of internship opportunities for career clarification.

Access to the job market

Past research has found WIL significantly enhances graduate employment (Silva et al., 2018), a result this study confirms. Students reported that internship experience is often a recruitment requirement set by employers in China, especially in the non-public sector, as experience is a way of proving abilities. Internships also offered opportunities for students to demonstrate their abilities to qualify for employment, and this is often one of the recruitment strategies adopted by many companies. In fact, 5 out of the 19 interviewees have taken up job offers from the companies where their internships took place.

Facilitating factors

A formal WIL structure

The primary facilitating factor widely appreciated by the research participants is the very existence of a structured WIL program, which formally integrates internships into their curriculum with designated time periods and which offers credits. This institutionalized arrangement is ‘like a mandate’ which ‘guarantees our right to do internships’ (S15), avoiding direct conflicts with coursework and research work assigned by academic supervisors at the university. Without a formal WIL arrangement in place which is the case with other engineering programs at the university, students often find it a struggle to carry out internships. As one interviewee described:

> In other schools, some professors will ask you to work on their research projects from the first day of

> your master study to the day you graduate. If the projects are a good match with students' studies, of course it's good. Sometimes it's not. Students want to do internships, but professors won't allow them, so a lot of them do internships secretly. (S6)

A curriculum with breadth that allows choices and flexibility

A distinctive feature of the French engineering education is it places a strong emphasis on the basic sciences and based upon a solid scientific foundation, students are trained to become industrial managers able to direct major projects, as perceived by the French vision of engineers (Lema îre, 2017). While the students found their training during the foundation years of the program to be demanding and 'far more intensive than other programs' they have generally reported benefiting from the solid foundation it has helped to lay for engaging in future studies. The strong mathematics and physics education also helps to shape thinking and build learning skills. 'My training has made it possible for me to quickly get started on something new' (S12). Some students also recognize the value of a broad and general approach to their engineering education. Unlike students in other engineering programs who are registered to a specialization immediately upon entry into the university, students of the SFEP have been given more time and flexibility to discover their interest before finally deciding upon a specific area of study on which to focus. Students are thus better equipped to cross over into other disciplines and their future development paths have been broadened, making it possible for them to pursue either engineering practice or research careers. Classes in other areas or on the periphery of engineering that didn't seem useful at the time were later found to be useful during their internships, such as business management and law. The fact that it is an international program also opens up new paths for students as they have been afforded opportunities to work at partner multinational companies of the school to experience different work cultures, leading some to decide to take up international careers outside China.

Institutional support

As literature has shown, support from both the university and industry is a key deciding factor in the implementation of internships (Atkinson & Stanwick, 2016; Luk & Chan, 2020). Participants in this research have also mentioned the importance of the support mechanism in place, especially a network of partner companies which can offer internship opportunities to students, an alumni network and information portals for intern positions and career counselling, employability skills courses which are part of the curriculum and tutorials on CV preparation and interview skills. Industry mentor support is one of the most important facilitating factors. Students report that mentors have not only coached them in their professional roles but have also offered career guidance, made job recommendations and written letters of recommendation in support of students' PhD applications.

Challenging factors

The struggle of the triple commitments of coursework, thesis and internships

One of the major differences between the two engineering education systems lies in the

emphasis on research in the Chinese system. Writing a master's thesis, which constitutes a significant academic research commitment, is a requirement for obtaining a Chinese master's degree. On the French engineering education side, coursework and practical experience are the primary methods of training. As SFEP is designed to satisfy the requirements of both systems, SFEP students experience the triple pressure of completing a large number of course credits, a thesis, and internships. All interviewees have expressed experiencing challenges in balancing the three, resulting in some coming up with compromising strategies, such as prioritizing research and internships over coursework:

> Everyone needs to make a choice about which path to take. Should they study all the courses well, or should they just focus on the direction they want to work on in the future? The ones choosing the second paths spent minimum time to do courses and used the time saved to join research teams to do research or do internships in companies. (S1)

The complex dynamics of the learner/supervisor/mentor trio

The learner/university supervisor/industry mentor trio in the form of regular interactions, follow-ups, and reflexivity is regarded as essential throughout the WIL process in French engineering education (Rouvrais et al., 2020). In the Chinese engineering education context relationship among the trio is more complex. In many cases not only do university supervisors not participate: they forbid their students from taking up internships altogether (Du et al., 2017). Instead, graduate students are frequently required to work with their professors on research projects, regardless of whether or not they are aligned with students' learning goals. Commonly, the relationship between supervisors and graduate students conforms to a ‘boss-employee’ model (Wang et al., 2019). Notably, in this study students have praised faculty affiliated with SFEP as they are familiar with the curriculum structure and ‘do not get in the way of internships’. Although they do not get in the way, faculty are not seen to have played a visible role in facilitating internships. Instead, SFEP has an internship management team that undertakes much of the responsibility for this.

This lack of faculty involvement is rooted in larger structural factors, with regard to both faculty composition and evaluation at Chinese universities. Most universities recruit Ph.D degree holders as engineering faculty members and they generally lack industry experience (Zhu et al., 2020). Consequently, faculty tend to follow the traditional academic path of graduate student training by focusing solely on the academic aspect. Meanwhile, due to research-dominant evaluation criteria, faculty are under pressure to publish. Internships, which take valuable research labor away from the research projects of faculty members, lead to conflicts (Du et al., 2017). The situation is exacerbated by the fact that faculty are not properly rewarded for education responsibilities. Consequently participation in practical training is especially lacking in the evaluation criteria of most universities (Zhu et al., 2021).

On the other hand, although industry mentors have been reported to play a positive role in guiding internships, it is unclear to what extent they are facilitating students’ learning goals, instead of simply work output.

The dichotomy of generalization and specialization

The tension between the curriculum and the job market is a frequently emerged theme in this study, particularly concerning the conflicts between generalization and specialization. Despite the prevalent rhetoric in industry and academia in recent years emphasizing the training of T-shaped talent, neither universities nor the job market seem truly aligned with this philosophy. The program under study is one of the few engineering programs in China that nurtures interdisciplinary and generalist engineers. While the program aims to cultivate top talent for the future, students have reported that the demands of the job market suggest otherwise. They have faced rejections for both internships and job positions due to their lack of a specialized background. As two students stated:

> Our goal is to become general engineers, and in order to achieve it, we have learned a lot of things. However, when this is put into the domestic context, it seems that there is no place that needs a generalist engineer. They need specialized people who can work on technical jobs. (S3)

> Companies here already have a fixed mindset, as if they should only recruit people who have received specialized training, but in fact, the ability to learn and the potential for development are more important. However, when there is a big pool of people to choose from, companies don't want to look into people's potentials. They just do a quick selection based on CVs. (S14)

Students reported that their broad generalist training has often put them at a disadvantage in the local job market as there is relatively low domestic recognition for generalist engineers. They have discovered that even major Chinese tech firms such as ByteDance and Baidu prefer graduates with specialized training, and only a few niche future-oriented positions do not require much specialization. As a result, generalists often find themselves seeking sales and management positions.

> Generalists are now at the bottom of the corporate ladder. Tech companies only need specialized people to write codes. Generalists like us are only recognized in some emerging interdisciplinary companies. Everywhere else they prefer those IT majors. (S1)

> There's not much research in French engineering education. You can get a job after taking courses and doing internships, which may be compatible with the French job market. But for China, this model is not so suitable. If you know a little bit of everything, but are not specialized enough in any one thing, it's hard to find an engineering job. Because graduate students in China all do research in labs with their supervisors. If you lack research experience, you can only work in sales or management. (S11)

The impact of WIL internships on professional identity

WIL can facilitate the development of students' professional identity and potentially lead to their enculturation within a CoP (Eames & Bell, 2005; Zegwaard & Coll, 2011). In this study, the students adhere to a curriculum based on the French engineering education model, yet the WIL exposes them to a predominantly local Chinese work setting. What impact do WIL internships have on their professional identity as they engage in the local engineering CoP? The answer to this research question gives rise to three themes, focusing on the concept of the engineer, engineering qualifications, and career path navigation.

The concept of the engineer

In France engineers enjoy a high social rank where they constitute the mainstay of high-level managers in French industries, different from other countries where these positions are occupied by science Ph.Ds (Lema ître, 2017). In China, engineers do not enjoy as high a social status and, in fact, the title of engineer lacks proper regulation (Qiao et al., 2023). This is reflected in most interviewees' understanding of the difference in the concept between the two countries. 'Engineers are viewed as elites of society in France, whereas in China, they are just ordinary science and technology graduates' (S6). Students understand that the concept of engineer in France is broad, signifying an engineering leader or manager rather than merely a technical professional. While they have been trained to become the elite French 'ingénieur' able to direct major projects, the students do not believe the French concept of the engineer aligns with the local reality in China, where the job market appears to predominantly offer roles that require specialized technical expertise.

> The purely French model will not work well in China. Without a very clear specialization, it doesn't match the Chinese job market. Here they focus on specialized skills. There is no such thing as the kind of new graduates who come in and become managers. (S6)

The majority of the research participants identified more with their local science and engineering professional identity rather than the concept of the French elite engineer. While students appreciate various aspects of their education model, such as the solid foundation in basic sciences, the freedom to choose afforded by the breadth of their training, the WIL design, and the multicultural nature of the program, their professional identity is clearly aligned with the local Chinese context.

> The job market in China is demanding as it is and when you tell us we will be trained to become some kind of elite, it just feels a bit disconnected. In fact, everyone feels more in touch with their local reality. I don't feel that I am a French engineer just because I had this education. (S12)

The engineering qualifications

Students have also grappled with the recognition of their qualifications. They have reported that while the engineering diploma certified by CTI is highly esteemed by French and European companies, its recognition in the Chinese job market is limited. The international nature of the program does not necessarily confer prestige. TNE programs have encountered stigma in China in recent years due to high tuition fees and low entry and quality requirements of some programs. Although SFEP is a high-quality non-profit program that attracts top students, its reputation has been somewhat affected by the tarnished image of other TNE programs. Consequently, students have resorted to relying on the brand of their local university and downplaying the name of SFEP to mitigate potential misunderstandings with employers, as described by two students.

> I remembered my interview at ByteDance for my internship. They looked at my CV and asked me, "Did you enroll by passing the university entrance exam like other students? Is your school a Chinese-foreign cooperative school where you paid a lot of tuition? (S1)

> In my first application to the internship position, I mentioned the name of the school and my study abroad experience in France. I didn't even pass the CV screening, while students from other schools did. The second time I left out the name of school and only mentioned what major I was in and this time and I immediately got an interview. (S18)

Furthermore, students have discovered that French engineering schools have limited visibility in the Chinese job market. Employers are primarily familiar with top Anglo-Saxon universities, and a French engineering school offers little added value. In recent years, as Chinese higher education has gained stronger recognition globally, the value of studying abroad has diminished in China (Liu, 2022). In the case of three interviewees, they were offered the opportunity to participate in double degree programs at the French partner institutions of SFEP but declined, opting instead to pursue a specialized research path locally.

Career path navigation

Students demonstrated the capacity to make informed career decisions based on their developmental needs, whether involving entry into the job market or pursuit of further academic studies. They acknowledge the comprehensive training they have received, particularly during their undergraduate studies, and deliberate between specializing in order to meet traditional job market requirements or seeking roles that value versatility and future potential.

Embracing the local path. Many students opt to pursue a local trajectory, working with a master thesis supervisor to develop research and concentrating on a specific specialization during their master-level study. They embrace the Chinese profile of the engineer and cultivate their specialization to establish legitimacy within the local CoP. Recognizing that 'companies are outcome-oriented, requiring immediate work readiness' (S19), these students align their focus accordingly:

> Because of the more general education we had in the undergraduate stage, I really had to do some catch up. When I looked for internships, I had to work really hard to cram in a lot of IT studies. Because I did start a lot later than a IT major. But companies don't care what happened. (S10)

Challenging the status quo. There are some who uphold the value of the generalist approach in their training and refuse to simply accept the prevailing local job market reality. Their internship experience reinforced their belief in the training they have received. They challenge the fixed mindset of the industry and believe in the genuine potential for generalists in the long run. These students seek jobs that are more future-oriented or pursue employment with French or European companies, which hold greater recognition of the French engineering education model.

> I think there’s a real need to train people for the jobs that are yet to emerge. Our professors asked us to ‘dive in’, that is, you were given a task that you were completely unfamiliar with and then given some information to figure it out on your own. I did sometimes miss the bit-by-bit traditional way of learning, but then during my internship I realized you do need to dive in to a greater extent. It's unrealistic to just teach people to do things bit by bit based on an established knowledge system in the

> traditional way when you're training people for future jobs or accomplishing new things never done before. That realization was important. (S7)

Prioritizing work-life balance. As students engaged with the local engineering CoP, most encountered corporate pragmatism where interns are frequently expected to perform at the level of regular employees (Du et al., 2017). Students reported high work intensity, with some expressing sentiments such as 'Each person is a cog in a machine' (S11). Some experienced the prevalent '996' culture at tech companies, which entails working from 9 am to 9 pm, six days a week. While a few accept this as the norm, most interviewees regard work-life balance as an important criterion in their job search. Despite being among the top students in China and excelling in rigorous academic competitions, they are unwilling to succumb to 'involution,' a widely popular term in China in recent years denoting excessive competition leading to minimal improvement. Instead, they seek jobs that do not demand frequent overtime work, with greater equality and respect for employee rights. They recognize the significance of pursuing personal projects in addition to career goals, emphasizing the importance of achieving a balance between personal and professional aspirations.

Discussion and conclusion

This study embarked on an exploration of WIL internships through the theoretical framework of situated learning, as articulated by Lave and Wenger (1991) and Wenger (1998), focusing on the social and situated nature of learning within a CoP. Central to our inquiry was the placement of the learner at the core of the experience, aiming to understand how students interpret their internship experiences within the broader narrative of evolving into engineers. This approach challenges the prevailing employability discourse that often frames learners as deficient, needing to conform to labor market demands. Our research distinguishes itself by examining the dynamic interplay between work and learning, as well as the contrasting cultures of engineering education and practice in China and France. This was achieved through the lens of Chinese students who have navigated French engineering education and engaged with local Chinese engineering CoPs.

The positive perception of WIL experiences by students aligns with existing literature, underscoring its significance in competency development (Crebert et al., 2004, 2004; Orrell, 2011), theory-practice integration (Patrick et al., 2008), and easing the transition into the labor market (Bilsland et al., 2019; Silva et al., 2018). Our findings further unveiled students' perceptions of facilitating and impeding factors of internships, emphasizing the importance of a structured WIL framework, institutional support, and the challenges associated with balancing academic obligations, resonating with prior research (Jackson, 2015; Patrick et al., 2008).

Significantly, this study sheds light on critical issues within Sino-French graduate engineering education, notably the generalization-specialization dichotomy. The generalist approach of French engineering education presented both advantages and challenges in the Chinese context. While students appreciated the breadth of the curriculum for providing a

strong scientific foundation and flexibility in exploring diverse areas of study and practice, it also created a mismatch with the prevailing norms of the local Chinese CoP, which prioritize specialization in selecting new members. This study also highlights the strain induced by the amalgamation of master thesis, coursework, and internship requirements from both educational systems, suggesting a reevaluation of traditional practices to alleviate student burdens and foster innovation. Additionally, the study diverges from existing literature by offering a novel perspective on the role of faculty members, discussing the implications of faculty composition and the dominance of research-focused evaluation criteria in Chinese universities.

Furthermore, the study paid special attention to the impact of WIL internships on students' professional identity development. Consistent with previous studies, we found that WIL significantly contributes to students' professional identity formation and their integration within a CoP (Eames & Bell, 2005; Jackson, 2017; Zegwaard & Coll, 2011). The unique interplay between the engineering education systems and cultures of China and France provided a rich backdrop for examining the identity formation of students. They exhibited a strong sense of agency in navigating their professional trajectories, critically evaluating CoP norms, and integrating elements from both educational models to fulfill their developmental needs, without categorizing themselves with specific national labels.

In light of our findings, it becomes evident that the journey of becoming an engineer is profoundly influenced by the intricate interplay between educational structures, cultural contexts, and individual agency. The experiences of the students in this study unveiled an array of challenges and triumphs, underscoring the transformative potential of WIL when thoughtfully integrated within diverse educational paradigms. This study, therefore, not only contributes to the discourse on bridging education with the labor market through WIL but also invites a deeper reflection on how educational institutions and communities of practice can work together to foster environments that are responsive to the nuanced needs of learners navigating global and local landscapes. As we look towards the future, it becomes imperative for stakeholders in engineering education to embrace the complexities of cross-cultural learning experiences, recognizing the value of flexibility, support, and a learner-centered approach in cultivating the next generation of engineers.

Acknowledgments

This material is based upon work supported by the Philosophy and Social Sciences Research Grants of the Ministry of Education of China (Grant No. 22JZDW002).

References

Atkinson, G., & Stanwick, J. (2016). *Work-based learning and work-integrated learning: Fostering engagement with employers*. NCVER.

Billett, S. (1994). Situating Learning in the Workplace – Having Another Look

atApprenticeships. *Industrial and Commercial Training*, *26*(11), 9–16.

Bilsland, C., Carter, L., & Wood, L. N. (2019). Work integrated learning internships in transnational education: Alumni perspectives from Vietnam. *Education + Training*, *61*(3), 359–373.

Cai, Y., Zhu, M., & Zhang, Ji. (2019). Study on the Current Situation and Trend of Curriculum Mode in Dual System Universities in Germany. *Research in Higher Education of Engineering*, *6*, 180-185+200.

Chatzis, K. (2010). Theory and Practice in the Education of French Engineers from the middle of the 18 th Century to the Present. *Archives Internationales d'Histoire Des Sciences*, *60*(164), 43–78.

Choy, S., & Delahaye, B. (2011). Partnerships between universities and workplaces: Some challenges for work-integrated learning. *Studies in Continuing Education*, *33*(2), 157–172.

Coll, R. K., Eames, C., Paku, L., Lay, M., Hodges, D., Bhat, R., Ram, S., Ayling, D., Fleming, J., Ferkins, L., Wiersma, C., & Martin, A. (2009). *An exploration of the pedagogies employed to integrate knowledge in work-integrated learning*.

Crebert, G., Bates, M., Bell, B., Patrick, C., & Cragnolini, V. (2004). Developing generic skills at university, during work placement and in employment: Graduates' perceptions. *Higher Education Research & Development*, *23*(2), 147–165.

CTI. (2023). *The CTI's major criteria and procedures engineering degree at master's level*. https://www.cti-commission.fr/wp-content/uploads/2023/07/RO_Referentiel_2023_ENGLISH.pdf

Du, Y., Li, G., & Wang, D. (2017). Problems in Practical Teaching of Full-time Professional Degree Postgraduates and Countermeasures - Based on Empirical Analysis from Interview with Experts. *Journal of Graduate Education*, *2*, 69–74.

Eames, C., & Bell, B. (2005). Using sociocultural views of learning to investigate the enculturation of students into the scientific community through work placements. *Canadian Journal of Science, Mathematics and Technology Education*, *5*(1), 153–169.

Eames, C., & Cates, C. (2011). Theories of learning in cooperative and work-integrated education. *International Handbook for Cooperative and Work-Integrated Education: International Perspectives of Theory, Research and Practice*, *2*, 41–52.

Eames, C., & Coll, R. K. (2006). Sociocultural views of learning: A useful way of looking at learning in cooperative education. *Journal of Cooperative Education & Internships*, *40*(1), 1–13.

Edwards, D., Perkins, K., Pearce, J., & Hong, J. (2015). *Work Integrated Learning in STEM in Australian Universities: Final report: Submitted to the Office of the Chief Scientist* (p. 120). Australian Council for Educational Research (ACER).

Embassy of France in China. (2023). *Sino-French Joint Higher Education Institutions*. https://cn.ambafrance.org/IMG/pdf/2022-2023_brochure_ifc_cn.pdf

Hora, M. T., Parrott, E., & Her, P. (2020). How do students conceptualise the college internship experience? Towards a student-centred approach to designing and implementing internships. *Journal of Education and Work*, *33*(1), 48–66.

Jackson, D. (2015). Employability skill development in work-integrated learning: Barriers and best practice. *Studies in Higher Education*, *40*(2), 350–367.

Jackson, D. (2017). Developing pre-professional identity in undergraduates through work-integrated learning. *Higher Education*, *74*(5), 833–853.

Jackson, D. (2018). The influence of Work-Integrated Learning and paid work during studies on graduate employment and underemployment. *Higher Education*, *76*, 403–425.

Jackson, D., & Bridgstock, R. (2021). What actually works to enhance graduate employability? The relative value of curricular, co-curricular, and extra-curricular learning and paid work. *Higher Education*, *81*(4), 723–739.

Jackson, D., & Dean, B. A. (2023). The contribution of different types of work-integrated learning to graduate employability. *Higher Education Research & Development*, *42*(1), 93–110.

Jackson, D., & Rowe, A. (2023). Impact of work-integrated learning and co-curricular activities on graduate labour force outcomes. *Studies in Higher Education*, *48*(3), 490–506.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Lema ître, D. (2017). Current developments in the French engineering education system. *European Journal of Engineering Education*, *42*(2), 131–141.

Lin, J. (2023). Construction of the National Institute of Outstanding Engineers: University-enterprise All-round In-depth Cooperation to Cultivate High-level Outstanding Engineers. *Research in Higher Education of Engineering*, *5*, 7–17.

Lin, J. & Geng, L. (2019). Research on the Government Action and Typical Models of the United States and Britain's Multi-Party Cooperative Education. *Research in Higher Education of Engineering*, *4*, 52–65.

Liu, J. (2022). *Top Chinese graduates opt to stay at home for postgraduate study*. Times Higher Education. https://www.timeshighereducation.com/news/top-chinese-graduates-opt-stay-home-postgraduate-study

Liu, M. (2011). A Probe into the "Grandes Ecoles" Students' Internship and Some Inspirations. *Comparative Education Review*, *33*(9), 22–25.

Luk, L. Y. Y., & Chan, C. K. Y. (2020). Adaptation and validation of the Work Experience Questionnaire for investigating engineering students' internship experience. *Journal of Engineering Education*, *109*(4), 801–820. https://doi.org/10.1002/jee.20351

Marginson, S. (2023). Higher education as student self-formation. In S. Marginson, B. Cantwell, D. Platonova, & A. Smolentseva (Eds.), *Assessing the Contributions of Higher Education* (pp. 61–87). Edward Elgar Publishing.

Orrell, J. (2011). *Good practice report: Work-integrated learning*. Australian Learning and Teaching Council.

Patrick, C., Peach, D., Pocknee, C., Webb, F., Fletcher, M., & Pretto, G. (2008). *The WIL report: A national scoping study*. Australian Learning and Teaching Council. https://eprints.qut.edu.au/216185/1/WIL-Report-grants-project-jan09.pdf

Qiao, W., Fu, J., & Wang, S. (2023). Challenges and Counter measures in Cultivating Outstanding Engineers. *Journal of Science, Technology and Education Studies*, *3*(2), 46–61.

Qie, H., Liao, L., & Wang, S. (2019). A Comparison of the Industry-education Cooperation Modes in Overseas Universities. *Research in Higher Education of Engineering*, *5*, 88–

96.

Remaud, B., Martin, R. P., Sánchez, T., & Arditti, J. C. (2010, October 14). Using industry internships to improve the quality of engineering higher education in Europe. The experience of French graduate engineering schools. *Proceedings of 2nd International Conference: Institutional Strategic Quality Management*. 2nd International Conference: Institutional Strategic Quality Management, Sinaia, Romania.

Robson, J. (2023). Graduate employability and employment. In S. Marginson, B. Cantwell, D. Platonova, & A. Smolentseva (Eds.), *Assessing the Contributions of Higher Education* (pp. 177–196). Edward Elgar Publishing.

Rouvrais, S., Remaud, B., & Saveuse, M. (2020). Work-based learning models in engineering curricula: Insight from the French experience. *European Journal of Engineering Education*, *45*(1), 89–102.

Silva, P., Lopes, B., Costa, M., Melo, A. I., Dias, G. P., Brito, E., & Seabra, D. (2018). The million-dollar question: Can internships boost employment? *Studies in Higher Education*, *43*(1), 2–21.

State Council. (2017). Opinions on Deepening the Integration of Education and Industry. http://www.gov.cn/zhengce/content/2017-12/19/content_5248564.htm

Tennant, S., Murray, M., Gilmour, B., & Brown, L. (2018). Industrial work placement in higher education: A study of civil engineering student engagement. *Industry and Higher Education*, *32*(2), 108–118.

Trede, F. (2012). Role of work-integrated learning in developing professionalism and professional identity. *Asia-Pacific Journal of Cooperative Education*, *13*(3), 159–167.

Wang, M., Guo, R., & Ma, S. (2019). Relationship Between Professional Degree Postgraduates and Tutors Based on ISM. *Heilongjiang Higher Education Research*, *4*, 104–109.

Wenger, É. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.

Yu, L., Chen, H., Yin, C., Tang, H., Xu, P., Duan, F., Zhang, W., & Wang, L. (2013). An Exploration and Practice on Engineers Training with the Involvement of Enterprises. *Research in Higher Education of Engineering*, *3*, 62-70+75.

Yuan, J. & Lei, Q. (2023). A Comparative Study of Two Models of Communication Courses for Engineering Majors in American Universities: Take Purdue University and MIT as Examples. *China Higher Education Research*, *2*, 89–95.

Zegwaard, K. E., & Coll, R. K. (2011). Using cooperative education and work-integrated education to provide career clarification. *Science Education International*, *22*(4), 282–291.

Zhu, K., Ma, J., & Cai, Y. (2021). Influencing Factors and Challenges of Organizational Innovation in Industry-education Integration in the Context of Emerging Engineering Education. *Research in Higher Education of Engineering*, *2*, 39–46.

Zhu, Z., Ma, Y., Zhou, H., & Li, M. (2020). The Situation and Suggestions on Improving Practice Ability of Teachers in Engineering Universities. *Research in Higher Education of Engineering*, *4*, 88-93+148.