International Journal of Engineering Education Vol. 39, No. 2, pp. 332–341, 2023
Printed in Great Britain

0949-149X/91 $3.00+0.00
© 2023 TEMPUS Publications.

Investigating Graduates' Feedback for the Implementation of Project-Based Learning in Electrical Engineering Undergraduate Program*

JINSONG TAO[1], UMAIR BACHA[1], STEPHEN C MCCLURE[2], CUNHUI ZHANG[1] and XISHAN WEN[1]
[1] School of Electrical Engineering, Wuhan University; Luojiashan, Wuchang, Wuhan, Hubei Province, P. R. of China, CP 430072. E-mail: Jamson_tao@163.com
[2] State Key Lab of Information Engineering in Surveying, Mapping, and Remote Sensing (LIESMARS), Wuhan University, PR of China, Luoyulu, Wuchang, Wuhan, Hubei Province, P. R. of China, CP 430079.

In order to evaluate the Integrated Pedagogy for Specialty Courses (IPSC), school of Electrical Engineering and automation of Wuhan University baccalaureate graduates were surveyed through an instant message tool. The former students contributed feedback on the methods, noting ways in which the IPSC pedagogy prepared them for independent literature reviews, project design, and implementation. They believed that project-based learning in particular, was useful and mirrors real world challenges while and the literature review enhances student's ability to integrate information. Furthermore, they indicated that the IPSC pedagogy equipped them with problem solving and critical thinking skills useful throughout both at work and in their larger lives. Survey respondents emphasized the need for more on-site experiments and visits in undergraduate engineering curricula. Our motivation was to provide some kind of evidence to support the implementation of project-based learning and literature review content at all stages of the electrical engineering undergraduate program to make it more relevant and meaningful for students. The analysis of these results, however, does suggest that life-long learning and independent learning abilities must be cultivated at the stage of higher education.

Keywords: lifelong learning; independent learning; graduates' feedback; Integrated Pedagogy for Specialty Courses (IPSC)

1. Introduction

The concept of ''involution'' has diffused across China, an indication that the domestic workplace is saturated with university graduates. Mass higher education has resulted in a more heterogeneous population of students in terms of their knowledge base, social background, and motivation. [1] Economic circumstances, however, represented by employment, unemployment and the level of investment, set the volume of career opportunities available for graduates. [2] Thus the increase higher education gross enrollment rate in China means that graduates having high entry expectations might not be satisfied with the workplace realities. For most young people, integration into the labor market is long and difficult as graduates are increasingly vulnerable to unemployment and underemployment [3]. Therefore, how to strengthen the employment competitiveness of engineering graduates has become a hot topic in Chinese universities. Every Chinese university, even the top 10, has established employment guidance and career planning centers.

Almost all Chinese colleges and universities have job training centers, which provide students with social training in the form of lectures except for majors [4]. Although job training should not be an important part of the national famous colleges and universities. A Chinese television entertainment shows that a doctoral graduate student from Chinese top 2 university was anxiety on his occupation, and the guests criticize that ''Top 2 universities in China should cultivate you to let our country believe in the truth instead of looking for job [5]. The authors deeply feel the same way. Of course, as individual needs to be recognized by the society, professional knowledge and Emotional Quotient (EQ) are both worthy of attention, although the congenital factors of the latter account for a certain proportion, and special training is not enough. The one-child policy has also led to the intensification of this kind of internalization. Many remarks, such as not losing at the starting line, have made people utilitarian in their children's education. This form of education has never achieved the goal of education to the maximum extent. But the ability to live is needed.

Educational institutions can improve resources and support efforts to increase graduating student's self-perception of employability, if graduates are to adapt to rapidly changing labor market landscapes [6]. Self-confidence includes explicit verbal skills and non-verbal behaviors used by people when

* Accepted 21 December 2022.

talking about achievements and qualities that increase their employability appeal in recruitment interviews [7]. Strengthening the links between education and the labor market and developing active labor market programs seem to be policy options for enhancing the employability of graduates, however the school-to-work transition remains highly sensitive to external factors, regardless of what level of educational attainment students might eventually achieve before entering the workforce [8].

Engineering educators can simulate aspects of the workplace in capstone courses, and companies can provide guidance to help mentor new engineers through the inevitable context gaps as indicated from weekly reflections and regular semi-structured interviews of new engineers collected during their first year of work [9]. Taking company requirements as basic guidance for higher education is a one-way demand, but until more effective and replaceable metrics are developed, these requirements can still be regarded as a benchmark for defining skill sets in demand and authentic assessment. Educators can use these requirements as a reference when summarizing the advantages and disadvantages of the existing curricula, and thus determine what skills current students must acquire to improve their competitiveness in a changing employment marketplace. A highly skilled and knowledgeable worker is an asset for any organization, and advanced skill sets are always associated with promotion, salary increases as well as their career success [10].

For a professional engineer, several educational skills are necessary. Thus, future engineers need to learn how to learn not just static knowledge. Lifelong learning skills are a must for all engineers, as the work environment is now international and rapidly changing [11]. Lifelong learning is all about generating and maintaining a positive attitude to learning for personal and professional development [12]. Liu and Houdek [13] showed that with a few carefully designed scholarly literature review modules and assignments, students could effectively learn to use proper literature review techniques in their research projects. They can use less time to accomplish more tasks. Project Based Learning (PBL) can stimulate students' motivation and accomplish more learning outcomes [14]. Students as future professionals also need to develop strong, flexible communication skills and the sensitivity to their audience. Different communications skills are required for the work place than academia and graduates must be adaptable [15]. Most engineers spend more than one third of their time at work writing documents and notes that connect them to the wider engineering community [16]. Universities also need to commit to professional learning opportunities for lecturers to develop their skills and confidence in relation to career management [17].

The higher education sector has been given the task of building a future society that learns in a complex and democratic environment. To enable students to undergo such transformations, they should learn how to learn and have a deep positive attitude towards learning. Students primarily represent the (future) lifelong learners. The positive association between lifelong learning and perceived employability means that lifelong learning plays a mediating role in the association between human capital and perceived employability [18]. Although subject to change, attitudes towards learning are an essential pointer of professional understandings and involvements in lifelong learning activities. Nurturing such a positive attitude towards lifelong learning could have far-reaching consequences on educational practices as well as employability in a changing environment [19]. Leading educational institutions such as Wuhan University can play a pivotal role in developing and disseminating educational theories and practices suitable for Chinese conditions and societal development goals.

Wuhan University is a key university directly under the administration of the Ministry of Education which was founded in 1893 and is considered one of the top 10 universities in China. It is one of the national "Project 985"and "Project 211" key universities and one of the first "double first-class" universities, and a testing ground for educational practices and innovations. In China, universities are classified into three levels: "Project 985" contains 34 universities; "Project 211" covers 112 universities including the "Project 985" universities; the rest belong to the third level. In 2017, a new classification was implemented: "Double first-class" universities are a group of high-level universities like Wuhan University, and disciplines like electrical engineering, expected to become or already are among the world's first-class institutions or at the forefront of their domain [20]. There are other changes in disciplinary classifications related to engineering.

The "New Engineering disciplines" is one new classification. This designation was established to insert into various engineering and scientific and technological fields a focus on high quality innovation, entrepreneurship, and dynamic adaptability to meet the needs of new industries of the future [21]. The new policy Initiative must be integrated into existing programs like the Integrated Pedagogy for Specialty Courses (IPSC) pedagogy. IPSC is a pedagogy that has been researched and practiced in Wuhan University and other universities for more

than 10 years [22, 23]. The original intention of this approach was to help cultivate critical thinking and lifelong learning skills among engineering students.

The IPSC combines two educational methods: Project-based Learning (PBL) and literature review. PBL is a means to help students quickly apply theoretical knowledge in a practical form and better grasp and consolidate knowledge. Project teams act as a catalyst to effectively develop collaborative, project management, communication and leadership skills [24]. PBL also provides students with generic professional skills such as problem-solving and communication skills, and helps students develop self-directed learning and self-assessment skills [25]. PBL has been applied worldwide in engineering education and has proven to be an effective and innovative pedagogy [26]. It emphasizes student centered instruction in realistic working conditions and scenarios, and is as relevant to Chinese engineering students as it is to students elsewhere in the world. The literature review method improves the students' specialty area English level, and connects the concepts and theories in textbook with the reality of the power system. It is unclear however, how our electrical engineering students are doing after graduation as they transition to work or advanced studies.

In order to understand students' feedback from the society after studying at IPSC, the author did a survey among matriculated undergraduate students who entered the Wuhan University electrical engineering program as freshman in the years 2012, 2013, and 2014 and who graduated four years later. The reason why authors choose to the group of graduated for more than four years is that in the structure engineering, respondents agree that four years of practical experience is adequate to adapt the technically independent work [27]. This paper is not only an examination of the value of this teaching method after five years, but also probes the former students opinions on their vocational education as well as their reflections on experiences during four years of university study, especially in the professional aspects. The rest of the paper is as follows, the second section is the Data collection method, section 3 is the data feedback and analysis, section 4 discusses the Feedback results which classified the questionnaire to 4 parts: Identification of respondents; Specialty knowledge percentage in work; IPSC reflection and suggestion to the School and Wuhan University. Section 5 is conclusion.

2. Data Collection

Before the start of each school year a QQ group is established for instant communications with students to smoothly implement our pedagogy every semester. These QQ groups allow us to interact with graduates while they are students and after their matriculation. These groups are a means to directly or indirectly track students with their permission in relation to their previous educational status after graduation and evaluate the relevance of the electrical engineering curricula, in particular the IPSC pedagogy, to the requirements of the evolving workplaces our graduates enter after matriculation.

The QQ discussion group established for the IPSC pedagogy was retained and students agreed to participate in a follow-up study five years after their matriculation. A questionnaire was designed to gather feedback from these graduates. Feedback and comments were collected from the 2012, 2013 and 2014 classes. The reason we choose this sampling frame is because the first five years after graduation is a critical time in career development.

A questionnaire was sent out through the QQ group to gather insights from former students after more than five years' time. These graduates might be able to objectively evaluate the advantages and disadvantages of teaching methods after they have experienced period of time in the workplace, and might also provide suggestions and constructive advice for the school. The questionnaire included seven questions as shown in Table 1.

This survey was designed to be easy for respondents to complete and at the same time, to probe for new insights into the student experience. Questions 1 to 5 are related to the pedagogy itself, to assess the effect of the method. Questions 6 and 7 are open-ended questions asking graduates to give some advice about the program and the higher education system. Question 7 relates to those formers students now that they have some experiments in society, and understand the realities of the workplace.

The survey was sent to 241 former students, 97 responded, a response rate of 40%. There were no drop outs from the survey. This is a very high response rate as online surveys typically have a response rate between 5% and 30%. This response rate was higher than is typical for online surveys [28]. Through our engineering graduates' feedback, we can decipher graduates thinking about schools and majors, teaching methods and suggestions on practical experiential content to understand the connection between formal education and the workplace.

3. Feedback and Analysis

As discussed in section 2, the questionnaire included Likert type, Multiple-Choice, and open-ended questions about the current status of former students, the number of years since graduation, and their assessments of the value of the IPSC peda-

Table 1. Questionnaire

Number	Question	Type
Q1	How many years have you worked?	Descriptive
Q2	What unit do you work in? A. state-owned enterprises; B. Private enterprises; C. Family business; D. Self-created company; E. Others (What?)	Descriptive multiple choice
Q3	How much do you think your expertise (from the IPSC pedagogy) has played a role in your current work? A. More than 80%; B. 60% ~ 80%; C. 40% ~ 60%; D. 20% ~ 40%; E. Less than 20%	Likert Scale
Q4	How the IPSC has affected your occupation or not?	True/false
Q5	If Questions #4 is yes, in which aspect has affected you? (If the answer is no, this question need not answer.) A. Literature review; B. Project Refinement; C. Project Completion; D. Others (What?)	Multiple Choice
Q6	Please give some suggestions for the IPSC, your suggestion is very important for teaching.	Open-end
Q7	Based on your experience, please give some advice on the school teaching system, your suggestions will provide useful help for teachers and students.	Open-end

Table 2. the current status of former electrical engineering students (Q2) participating in this survey, n = 97

Current Position	Number	Percentage	Type
A. State-owned enterprise	73	75%	1. State Grid of China; 2. China Southern Power Grid
B. Private enterprises	8	8%	n/a
C. Family business	0	0%	n/a
D. Self-created company	0	0%	n/a
E. Other (PhD, Civil Servant)	16	17%	PhD Candidate at Wuhan University, Xian Jiaotong University, Zhejiang University, Michigan State University and Drexel University
Total	97	100%	

gogy. The first two questions dealt with their current status, the second three questions focused on the pedagogy, and the last two questions probed for suggestions about the pedagogy and education in general.

3.1 The Respondents

Questions Q1 and Q2 dealt with the 97 respondents' current status, now many years since their baccalaureate graduation (Q1) and where they are working, Q2. More than half of these students have entered the workplace (54%), while 46% of the graduates continued their studies towards an advanced degree before entering the workforce, and nine were currently pursuing doctoral degrees at the time of the survey.

According to our investigation, the vast majority of former undergraduate students surveyed (73 out of 97, 75%) entered state-owned enterprises after completing their studies, especially two companies, the State Grid Corporation of China, the China Southern Power Grid Corporation and their subsidiaries, Q2. Historically, the School of Electrical and Automation of Wuhan University belongs to the Ministry of Electricity of the People's Republic of China, the precursor of these two major power companies, so this result is not surprising.

None of the respondents went to private enterprises, nor did they enter family business or created companies. The country encourages university graduates to create their own business, but almost none of the students in our major start their own businesses or join private enterprises. This is consistent with post- baccalaureate tracking statistics collected by Wuhan University [28].

3.2 Responses to Structured Questions in the Survey

There were four structured response questions in the survey, including one Likert scale question, Q3; two multiple-choice questions Q2 and Q5, and one true/false question, Q4. For Q3, respondents were asked,'' How much do you think your expertise has played a role in your current work?''. The response categories were five percentage ranges. Fig. 1 shows the distribution of responses across these categories.

The modal class for all respondents was C, (40% to 60%), as illustrated in Fig. 1. This conforms to our expectations, because only the students who are in the learning process attention to textbook content, while the students who are working do not actually apply much of the static content they acquired as undergraduate students.

Table 3 presents the aggregated Likert scale Q3 results grouped by years after graduation and by

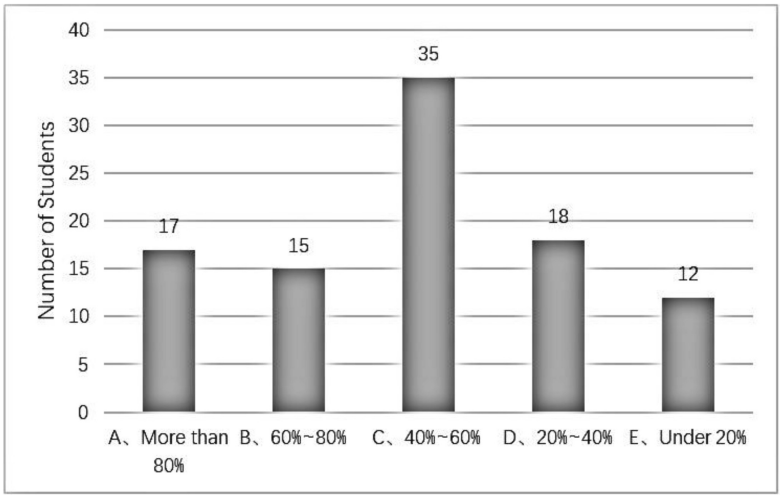

Fig. 1. Answers to (Q3), "how much do you think your expertise (from the IPSC pedagogy) has played a role in your current work?".

Table 3. Summary table of survey results (Q3) "how much do you think your expertise (from the IPSC pedagogy) has played a role in your current work?"

Frequency distribution of years after matriculation						
Years since graduation	**A**	**B**	**C**	**D**	**E**	**Grand Total**
0	100%	0%	0%	0%	0%	(9) 9%
1	25%	0%	38%	38%	0%	(8) 8%
2	11%	25%	36%	11%	18%	(28) 29%
3	0%	24%	48%	29%	0%	(21) 22%
4	0%	33%	67%	0%	0%	(9) 9%
5 and more	14%	0%	27%	27%	32%	(22) 23%
Grand Total	18%	15%	36%	19%	12%	(97) 100%

the student's evaluation of the role of their expertise in their current work. Since the respondents were from the freshman classes from 2012 to 2014, these former students had matriculated with their baccalaureate degree three to five years before the time of the survey questionnaire. If they continued on to master's degree, then is 3 to 0 years from graduation as a master's degree takes two or three years to obtain. If they were completing a doctoral degree, the working time is 0 years.

As seen in Table 3, although for all students the modal class was C, "40% to 60%" as shown in Fig. 1, the exceptions being the one year after graduation, with class C (40% to 60%) and D (20% to 40%) each including 38% of the students and the zero years after graduation in which all nine students fell into the A class (more than 80%). Looking at the table, it appears that expertise acquired in from the IPSC pedagogy was less relevant over time, however since the sample size was insufficient to fill the matrix this could not be empirically verified. Therefore, the time intervals were combined into two groups; "Group 1: 0 through 2 years" and "Group 2: more than 3 years", and used the Chi square statistic to empirically verify if there is a correlation between, years of work, and their response of Likert scale categories For Q3;" How much do you think your expertise has played a role in your current work?", Table 4.

As shown, in group 1, the modal class was A, while in group 2 the model class was C (40% to 60%). This distribution was statistically significant

Table 4. Q3 response data and Chi-Square results

Frequency distribution of post-graduates grouped by multi-year intervals						
Years since graduation	**A**	**B**	**C**	**D**	**E**	**Grand Total**
Group 1: 0 through 2 years	31%	16%	29%	13%	11%	(45) 46%
Group 2: more than 3 years	6%	15%	42%	23%	13%	(52) 54%
total	18%	15%	36%	19%	12%	(97) 100%

X^2 (4, N = 97) = 11.39, $p < 0.05$.

with $p > 0.05$. It can be inferred from these tables that the IPSC curricula eased the school to workplace or advanced education transition in the first years after graduation, while diminishing in importance over time. Subsequent questions drilled down to reveal ways in which the IPSC pedagogy was useful in their current endeavors. Furthermore, we can see from the table that the students who graduated from zero to two years think that expertise gained through the IPSC pedagogy played a significant role, which is because they are still using their expertise in doing research, but for the students who work right after graduation from bachelor's degree, if they do not do research, the ratio of expertise for their work will be less and less, which is a situation that needs attention, and we hope to support them by cultivating a lifelong learning approach.

Question 4 (Q4) and question 5(Q5) focused on the value of the IPSC pedagogy overall, and what parts of the pedagogy were most relevant to their current endeavors. Q4 asked if the IPSC pedagogy is helpful to their current work, true or false; 90 out of 97 respondents answered this question, respondents could select more than one choice. Among the students who answered the Q5 multiple choice question, 50% (49 respondents) indicated that teaching them how to consult the literature was helpful, as shown in the Fig. 2. Furthermore, 36% (35 respondents) found project implementation to be useful. The least relevant skill was writing, 3% (3 respondents), as illustrated in the Figure.

After graduation in the workplace or when they continue on to graduate studies, they must look to the literature to find solutions. For those in the workplace, there are many choices to be made during on-site project execution processes. Employers have high expectations for the students who graduated from a top 10 university, so they need to develop the capacity to independently frame and solve technical problems. Thus, PBL experiences were designed to mimic workplace settings so as to prepare students for their careers after schooling. The two open-ended questions probed the respondents to offer feedback on the entire IPSC approach and suggestions on ways to improve it and the electrical engineering program as a whole.

3.3 Open-ended Responses

The two open ended questions provided rich qualitative information concerning post-graduate baccalaureate insights into the effectiveness of IPSC pedagogy and their suggestions for improvements to the program going forward. The open-ended questions were:

Q6 "Please give some suggestions for the IPSC; your suggestion is very important for teaching."
Q7 "Based on your experience, please give some advices on the school teaching system, your suggestions will provide useful help for teachers and students."

The responses were transferred to a matrix so that emergent themes could be identified. Among the 97 respondents, 77 of them (79%) added comments to the open-ended question 6, while only 37 or 38% of the total answered question 7 (Q7). In-person interviews with two respondents revealed that this difference in response rates on the second open-ended question might be because the "the question was too big". The major themes in the responses to both Q6 and Q7 included curricula need updating to meet the changing workplace demands with more hands-on experiments, more on-site training, and closer guidance and supervision. Furthermore, several former students suggested that IPSC be introduced earlier and more widely across the electrical engineering curricula.

Respondents who answered Question 6 (Q6) gave two kinds of comments, no change and advice for improvements. Among them 19 of these former students (25%), agreed that "Now I am on a

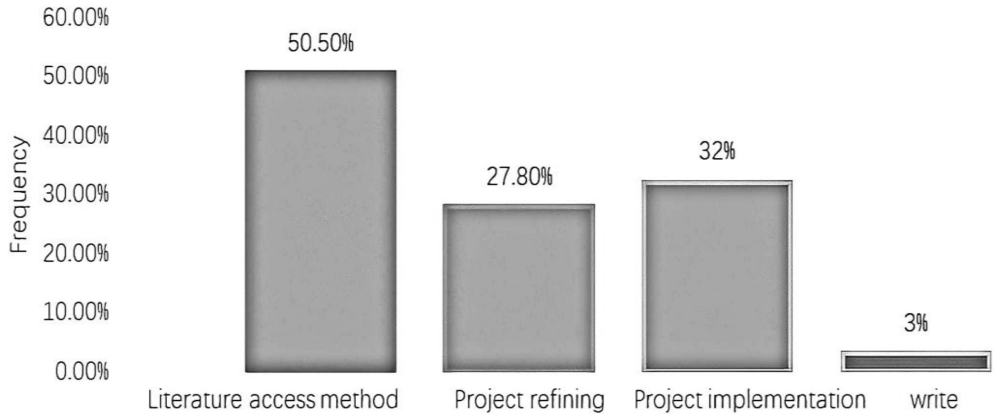

Fig. 2. Q5 Multiple Choices: If IPSC has affected your occupation, in which aspect has affected you?

research staff that needs to read lots of papers and scientific materials, I believe the information integration ability is significantly improved by this method. Thanks for providing a research opportunity and let me participate in his research team during undergraduate study.'' Another respondent wrote that ''. . . this method can be kept.''

Over half, 60% of the 77 former students who answered Q6 gave advice on improving the pedagogy, including adding more group discussions, more projects, and more hands-on experiments related to applications saying to ''. . . add some actual wiring methods of the power grid, equipment selection, operation mode introduction, etc., the application of electrical knowledge in the power grid combined with the actual explanation''

As the responses to Q6 suggest, former students felt that pedagogy provides a foundation for future work or research. About 25% of the 77 former students who answered Q6 advised that ''various learning courses be classified according to practical project applications'' and ''. . . therefore, IPSC at the undergraduate level should be more about guiding students to learn how to grasp the research process in a certain field and understand the current problems in the field . . .'' they hope that ''The project-based learning process can be more diverse, not only limited to software simulation, but also have some experiments to develop hands-on skills.''

The literature review element in the IPSC pedagogy enhances the student's ability to integrate information, but they said that they think more guidance is required so that students learn to distinguish between high quality and low-quality literature. Some of the 77 former students (19%) responding to Q6, also agreed that ''Literature reading has an important guiding role for research, but the understanding of literature reading is not enough when the pedagogy is implemented in school, and it may take practice after work to appreciate how to make students understand the role of literature in the learning process, and I hope teachers will experience more.''.

Another former student emphasized that ''English literature reading needs more detailed guidance from the teacher, because there are certain differences between the structure found in the English reading process and the Chinese literature''. Former students added that ''It is recommended that literature review studies be conducted while developing the ability to distinguish between high quality and low-quality literature''

A few former students (8%) mentioned that more hands-on activities and discussion could improve the method but that this requires closer guidance. One student commented, the ''. . . software EMTP is very helpful to my current work, but when I was doing it, I did not have time to study the software carefully, because the teacher's supervision was not enough, and of course because I was lazy, so I did not learn well, and re-learned after I arrived at the unit''. Students need deeper guidance until they are familiar with this software. five former students agreed that the on-site practice should be emphasized in engineering learning, ''More internships, visits the field to see the operation of equipment, operation and maintenance will be better for understanding the majority.''

The 12 students (32%), of the 37 who answered Q7 suggested that engineering education should link theory closer to practice and the curricula needs to be updated (14%). One respondent wrote, ''. . . Go to the field to learn more when you have the opportunity, and make a learning plan according to the actual needs of the future work'' and another commented, ''I hope the program can keep up with the times and expand more courses so that students can adapt right out of school''. The other 20 respondents (54%) who commented on Q7 gave a wide range of suggestions, for example, ''. . . I feel that we are still limited in learning about other disciplines, such as some general studies courses. . .'', so students get a wider, deeper perspective that enhances critical thinking, as one responded wrote the school could ''focus (more sharply) on the cultivation of learning ability, the learning of practical applications. . .''.

The survey shows that former students appreciated the IPSC approach, finding that PBL mirrors real world challenges and the literature review enhances student's ability to integrate information. They contributed useful advice on this pedagogy as refinements are made. They mentioned on-site experiments and on-site visits, specifically. The program already includes some on-site visits; however due to the particularity of the power industry and risks associated with electricity, we generally study it from a distance, not on-site. We have already made some improvements, so more practical experiments are on-site.

4. Discussion

Reflecting on the results of this survey, and encounters with students in classroom settings crystallize some relevant points about Electrical Engineering students graduating from Wuhan University and the challenges they face as they make the transition from undergraduate studies to the workplace or advanced degree programs. Despite efforts to encourage students to explore the private sector, they still prefer the security of public employment. As they graduate, students face intense societal pressures to fulfill familial obligations as well as to

begin their careers. The IPSC pedagogy prepares them with problem solving and critical thinking skills useful throughout their lives both at work and in their larger lives.

Most of the students surveyed choose the Iron-Rice-Bowl, preferring to enter the state-owned enterprises or the civil service, rather than the private or entrepreneurial sectors after graduation. Student want "stable" employment in the public sector even though this is not encouraged by the government. Our engineering graduates like other graduates from top-ranked universities prefer stable employment in the civil service and state-owned enterprises to the uncertainties of the private sector [29]. In 2021, only 13 graduates from Wuhan University chose to start their own businesses [30]. This is consistent with the number of graduates from other first-class universities in China who choose to start their own businesses. In the same year, only 27 graduates from Tsinghua University [31] and only 61 graduates from Peking University [32] directly started their own businesses, similar in proportion to Wuhan University and other universities. Given the high response rate to our survey, and the consistency between our descriptive results and other published data on university graduates, we infer than our qualitative results might be representative of Chinese engineering baccalaureate graduates more generally.

The first five years after graduation might be a confusing period for graduates. In this period, students need to consider things like housing, marriage and family, continuing studies, or their occupation. Therefore, this period is an extremely uncertain time of life in general as well as a career development watershed. This time also opens a broad space for development. Some graduates have a serious lack of life experience, after five years they will gradually stabilize and adjust to the workplace environment, and their educational experience recedes into the background. At this time the attention to career and career development will become more intense, and their ability to analyze and solve problems will likely improve, as our results suggest. At the same time, the IPSC pedagogy arms our graduates with lifetime learning skills.

Former student responses to the open-ended questions indicate that the IPSC pedagogy should be made available in the first and second years, so that college students can become acquainted with professional skills earlier. This could give students a more immediate grasp of current developments in their major, and increase their interest in professional learning. Survey respondents also put forward some useful suggestions in order to improve the IPSC method; the literature review component should enable students to more effectively identify the quality of articles and avoid detours. Students must learn to be critical readers and know the key journals in their specialty area, understand how to identify key papers in their specialty from citations in indexes such as the Web of Science, or Engineering indexes.

In their advice to the University and college, most respondents indicated the need for more practical learning courses, so that students can acquire practical experience earlier. In addition to learning professional knowledge, responding students expressed that practical operations have always been their weakest link. Some students suggest that our courses system should be changed to improve our specialty education. A student commented: 'The main aim of the university is to master the learning method, the learning content can be continuously consolidated in the later stage, and to master the concept of lifelong learning, cannot stop learning'.

5. Conclusions

In order to evaluate the IPSC pedagogy composed of PBL and literature review, we conducted a survey of former students from three to five years after their baccalaureate graduation. They contributed feedback on the methods, noting ways in which the IPSC pedagogy prepared them for independent literature reviews, project design, and implementation. They indicated that this program equipped them with problem solving and critical thinking skills useful in their life after graduation, as well learn how to find answers or research methods from literature when they encounter problems in their work.

The IPSC combines the direct transfer of course information with the project-based learning method. In this process, students increase their professional knowledge, and at the same time strengthen their communication and collaborative skills while completing curricular tasks. This pedagogy transforms passive learners into active agents by encouraging independent and cooperative learning. In turn, this transformation is conducive to improvement in their critical thinking and problem-solving skills with positive guiding effect on career development, post-graduation.

The analysis of these results suggests that lifelong learning and independent learning abilities must be cultivated in higher education. This meets the criteria established in the "Double First-Class" Universities [33] guidelines that direct institutions to combine knowledge acquisition, scientific research and capacity development, to actively build an application-oriented practical practice teaching system, to expand the quantity, type and

level of practical practice bases, and improving the quality monitoring and evaluation mechanisms of practice.

However, we can see from the feedback that most of the students surveyed choose the Iron-Rice-Bowl, preferring to enter the state-owned enterprises or the civil service, rather than the private or entrepreneurial sectors after graduation. Student want ''stable'' employment in the public sector even though this is not encouraged by the government. Also means they are just short of the spirit of struggle which is also needed to keep eye on and looking for problem-solving methods.

We recognize the limitations of this study in terms of sample size, control group, and research design; however, our motivation was to provide some kind of evidence to support the implementation of project-based learning and literature review content at all stages of the electrical engineering undergraduate program to make it more relevant and meaningful for students. Future studies should include more former students. Some improvement will be done according to the students' feedback; survey respondents emphasized the need for more on-site experiments and visits in undergraduate engineering curricula.

References

1. S. Nyüsti and V. Veroszta, Institutional Effects on Bachelor-Master-level Transition, *International Journal of Social Sciences*, **4**(1), pp. 39–61, 2015.
2. V. A. Strat, A. Davidescu and A. M. Paul, FDI and the Unemployment – A Causality Analysis for the Latest EU Members, *Procedia Economics and Finance*, **23**, pp. 635–643, 2015.
3. J. D. Ford, M. Paretti, D. Kotys-Schwartz, S. Howe and R. Ott, New Engineers' Transfer of Communication Activities from School to Work; *IEEE Transactions on Professional Communication*, **64**(2), pp. 105–120, 2021.
4. R. Garcia-Robles, F. Diaz-del-Rio, S. Vicente-Diaz and A. Linares-Barranco, An eLearning Standard Approach for Supporting PBL in Computer Engineering, *IEEE Trans. on educ.*, **52**(3), pp. 328–339, 2009.
5. A. Tymon, Charlotte Harrison & Sasa Batistic, Sustainable graduate employability: an evaluation of 'brand me' presentations as a method for developing selfconfidence, *Studies in Higher Education*, **45**(9), pp. 1821–1833, 2020.
6. G. Xiaosong, What do you think of Gao Xiaosong's statement that prestigious schools are important weapons for the country, and that elite schools should cultivate you with the world in mind?, [Online]. Available: https://www.zhihu.com/question/66406685.
7. H. J. Passow and C. H. Passow, what competencies should undergraduate engineering programs emphasize? A systematic review, *J. Eng. Educ.*, **106**(3), pp. 475–526, 2017.
8. D. A. Griffiths, Margaret Inman, Harriet Rojas & Kent Williams, Transitioning student identity and sense of place: future possibilities for assessment and development of student employability skills, *Studies in Higher Education*, **43**(5), pp. 891–913, 2018.
9. D. Raffe, Cross-National Differences in Education-Work Transitions, *In the Oxford Handbook of Lifelong Learning, edited by M. London*, pp. 312–328. New York: Oxford University, 2011.
10. P. Jarvis, Adult Education and Lifelong Learning: *Theory and Practice*, Routledge, London, 2004.
11. J. Michael, Where's the evidence that active learning works? *Adv. Physiol. Educ.*, **30**, pp. 159–167, 2006.
12. A. Diaz Lantada and J. L. Martin Nunez, Strategies for Continuously Improving the Professional Development and Practice of Engineering Educators; *International Journal of Engineering Education*, **37**(1), pp. 287–297, 2021.
13. C. Liu and R. Houdek, Teaching computer science graduate students scholarly literature review techniques; *36th Annual Frontiers in Education (FIE 2006)*; OCT 28–31, 2006.
14. F. Liwei, Improve Chinese Ability to Promote Development in Job Market; Proceedings of the 2nd International Conference on Education, *Economics and Management Research (ICEEMR 2018)*, **182**, pp. 222–225, 2018.
15. M. Bolino, M. Kacmar, W. Turnley and J. Gilstrap. A Multi-level Review of Impression Management Motives and Behaviors, *Journal of Management*, **34**(6), pp. 1080–109, 2008.
16. A. M. Zamfir, E. Militaru and E. O. Lungu, School-to-work transition of higher education graduates in four European countries; *Compare-A Journal of Comparative and International Education*, **50**(1), pp. 36–52, 2020.
17. P. Dias, A. Freedman, P. Medway and A. Pare, Worlds Apart: Acting and Writing in Academic and Workplace Contexts. Mahwah, NJ, *USA: Lawrence Erlbaum*, 1999.
18. M. Järlström, T. Brandt and A. Rajala, The relationship between career capital and career success among Finnish knowledge workers, *Baltic Journal of Management*, **15**(5), pp. 687–706, 2020.
19. P. M. Nimmi, K. A. Zakkariya and P. R. Rahul, Channeling employability perceptions through lifelong learning: an empirical investigation; *Education and Training*; **63**(5), pp. 763–776, 2021.
20. Ministry of Education of China, Ministry of Finance of China, National Development and Reform Commission of China. Implementation Measures for Coordinating and Promoting the Construction of First-Class Universities and First-Class Disciplines of the world. http://www.moe.gov.cn/srcsite/A22/moe_843/201701/t20170125_295701.html
21. Lin Jian; Further Solid Promoting the construction of New Engineering Disciplines: some thinking of the organization and Implementation of the Research and Practice Projects of New Engineering Disciplines, *Research in Higher Education of Engineering*, **5**, pp. 18–31, 2017.
22. J. Tao, S. C. Mcclure etc. Integrated Pedagogy for Specialty Courses in Chinese Engineering Education, *International Journal of Engineering Education*, **32**(5B), pp. 2184–2193, 2016.
23. J. Tao and S. Zhang etc. Extending engineering specialty course concepts in electrical engineering education, *International Journal of Electrical Engineering Education*, **52**(1), pp. 39–51, 2015.
24. Zhang zhinan, Zhuge Xun and Wang Liwei; Exploring the project-based Learning Model of Multi-level Closed-loop Feedback- A Case Study of Excellent Engineer Education and Training Plan 2.0 in Shanghai Jiaotong University; *Research in Higher Education of Engineering*, **4**, pp. 107–111, 2020.

25. J. Uhomoibhi and M. Ross, Globalization and e-learning: integrating university and professional qualifications for employability and lifelong learning, *Proceedings of the 8th International Conference on E-Learning. Book Series: Proceedings of the International Conference on e-Learning*, pp. 404–408, 2013.
26. F. P. Maciel Barbosa, C. M. Machado Ferreira, M. M. Travassos Valdez and C. I. Faustino Agreira, PBL Implementation in a Lighting Design Course, 978-0-947649-44-9/09, *IEEE*, 2009.
27. Robertson, IN; Survey of education and license requirements for structural engineers, *Journal of Professional Issues in Engineering Education and Practice*, **128**(3), pp. 120–124, 2013.
28. E. Deutskens, K. D. Ruyter, M. Wetzels and P. Oosterveld, Response rate and response quality of internet-based surveys: An experimental study. *Marketing Letters*, **15**, pp. 21–36, 2004.
29. Z. J. Bean, which companies have college graduates gone to? zhihu, [Online]. Available: https://zhuanlan.zhihu.com/p/103585120.
30. Employment Quality Report of Wuhan University Graduates in 2021, https://info.whu.edu.cn/info/2046/23710.htm.
31. Employment Quality Report of Tsinghua University Graduates in 2021, https://career.tsinghua.edu.cn/info/1031/4525.htm.
32. Employment Quality Report of Peking University Graduates in 2021, https://scc.pku.edu.cn/home!downloadCenter.action.
33. Ministry of Education of China, Ministry of Finance of China, National Development and Reform Commission of China. Guiding Opinions on Accelerating the Construction of Double First-Class Universities; 2018.8; http://www.moe.gov.cn/srcsite/A22/moe_843/201808/t20180823_345987.html.

Jinsong Tao received the MSc and DSc degrees in electrical engineering from Hubei University of Technology and Wuhan University, both in Wuhan, China, in 1997, 2006 respectively. During 2006 and 2007, He was as a visiting research associate in The University of Manchester, UK. He is currently an associate professor in Wuhan University. In 1989, he joined Wuhan Electric Transformer Factory, where he was an engineer involved with electric transformer design. From 1997 on, he came to the school of electrical engineering, Wuhan University. His current research interests include electromagnetic compatibility in power system, high voltage engineering, power system economics and intelligent transportation system.

Umair Bacha was born in Khyber Pakhtunkhwa, Pakistan, he got the bachelor degree in Electrical Engineering from Swedish College of Engineering and Technology Wah Cantt, Pakistan. Now he is a master candidate in Wuhan University and his interesting is High Voltage Engineering.

Stephen C. McClure is a research assistant at the State Key Lab of Information Engineering in Surveying, Mapping, and Remote Sensing (LIESMARS) at Wuhan University, PR of China. He holds a MA in Sociology and GISci from George Mason University, USA.

Cunhui Zhang was born in Yongzhou, Hunan Provice, P.R. China, he got the bachelor degree in Electrical Engineering from Hunan University, China. Now he is a master candidate in Wuhan University and his interesting is High Voltage Engineering.

Xishan Wen received the BS degree in high voltage technology from the School of Electrical Engineering at Xi'an Jiaotong University, Xi'an, China, in 1982, the MS and PhD degrees in high voltage technology from the School of Electrical Engineering at Wuhan University of Hydraulic and Electric Power Engineering, Wuhan, China, in 1985 and 1989, respectively. Currently, he is a Professor in the School of Electrical Engineering at Wuhan University. His major fields of interests include overvoltage of power systems, lightning protection, and insulation technique.