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Factors Influencing Employability of Civil Engineering Graduates in China*

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The employability of graduates is a metric to assess the teaching achievements of higher education. Employability is complex, multi-dimensional, and is closely associated with specific industry characteristics. Thus, employability must be studied for a specific major in order to provide any practical guiding significance. The aim of this study was to determine the major factors contributing to the employability of graduates in civil engineering and provide the basis for setting appropriate goals to effectively cultivate civil engineering professionals by improving teaching strategies. Recent graduates of civil engineering programs who graduated between two and five years ago were selected as the subjects, and questionnaires were completed by 279 graduates. The results showed that 88% of civil engineering graduates are working in a position related to their specialty. Graduates were more satisfied with their current positions and work environments than they were with their salaries and future career development prospect. We analyzed the factors contributing to the employability of graduates, and defined three major factors of occupational quality, development potential, and professional capacity. These data suggest guidelines for the rational setting of goals to effectively cultivate civil engineering professionals, design an improved practical curriculum, adjust teaching methods, and modify course assessment indicators.

Keywords: civil engineering; graduates; employability; influencing factors

1. Introduction

With continued social and economic development, higher education and the labor market for graduates have become highly competitive. Once undergraduates complete their studies at a university, they will face strong employment pressure. Because the graduates represent the core outcome of higher education, the employability competition of graduates has become the main metric of university success.

Improving the overall employability of graduates is an important concern for higher education at the university level [1]. In many countries, the employability of graduates is highly valued by the government, with expectations that higher education should contribute to national economic growth [2]. The employment of graduates of higher education has been studied by numerous researchers, however, there is no universally accepted definition of employability [3]. Most researchers agree that improved employability of graduates is important for universities. For example, Branine [4] reported a survey of 700 UK-based employers, in which more than 60% described problems of poor-quality graduates in terms of their employability skills. Thus, universities need to adjust their teaching strategies and overall preparation of students in order to improve this situation. Yoke [5, 6] recommended the inclusion of employability as a focus of the curriculum and providing multiple opportunities to develop a wide range of skills. Fugate and Kinick [7] established and verified indicator dimensions for employability. Gonzalez-Roma [8] examined the relationship between employability as established by Fugate and Kinick and employment status and work quality. Some studies investigated undergraduate students from different colleges and universities and analyzed their perspectives of employability [3, 9–11].

Many studies explored definitions, implications, and the relationship between employability and career development, with most concluding that employability is complex and multidimensional [1, 2, 12] However, different study objectives and perspectives and different subjects result in different or even opposite conclusions. For example, some studies emphasized the importance of generic skills and personal attributes [13, 14], suggesting that personal qualities may be more important than professional discipline, mastery of specialized knowledge, or even expert skills. In contrast, Purcell et al. [13] found variability in the importance of generic skills for specialist professional and technical occupations compared with general management, administration, and service occupations. It seems reasonable that for some technical professions, general skills may have limited value relative to more professional skills.

The different definitions of employability and conclusions of these studies have made it difficult

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for universities to determine the best teaching programs to improve the employability of students. To discuss employability skills, we must consider the following limitations of previous work in this field: (1) the extent to which the employability framework of graduates may vary due to industrial differences or specific disciplines has not been determined; (2) Current undergraduates at colleges and universities are typically used as subjects in some employability studies, such as those by Itanil and Srour [9], Tymon [3] and Tomlinson [11]. However, current undergraduates have not yet experienced in workplace competition, thus they have only limited knowledge of employability; (3) Some studies on the employability of graduates did not take into account potential differences for different occupations by graduates of different disciplines and major, only general factors were described for students without distinguishing majors. Thus, the study will focus on the following problems: (1) What is the current employment situation of civil engineering graduates? (2) What are the key elements determining employability of civil engineering discipline? (3) Does non-technical ability affect the career development of civil engineering graduates? Which ability has the greatest impact? (4) Does professional ability affect career development?

Addressing the above concerns is required to more comprehensively study graduates from civil engineering programs. In the past, engineers were considered individual technical contributors that required extensive and solid professional knowledge and practical skills [10], which are the assumed prerequisites of a civil engineer [15]. However, with the globalization of the economy, industrial development of the construction industry, and the wide application of computer information technology in the construction industry, modern construction enterprises become more international, scientific, technical, and modern, potentially requiring graduates to have more comprehensive skills. A good command of the employability framework necessary for success in the field of civil engineering is required to cultivate students that meet this market demand. Currently, little research has evaluated the employability of civil engineering students. Hence, this study focused on the real employability experiences of civil engineering graduates and their occupational development in engineering practice.

To achieve these objectives, our data were collected from civil engineering graduates from a single university who graduated two to five years ago. These graduates are now in the work force, and have a good understanding of the employability requirements of their industries, their perceived employability for occupation positions, as well as their strengths and weaknesses disadvantages. The objectives of this research is: (1) To investigate the current situation of the occupational development of the civil engineering graduates. (2) To identify the variables of employability of civil engineering graduates. (3) Our research provides suggestions for setting goals to cultivate civil engineering talents, adjusting the curriculum, and improving the teaching content and teaching mode. (4) A model for research on employability of graduates with other majors is described. These results suggest direction for teaching reform of the civil engineering major in colleges and universities to improve the employment competitiveness of students and reduce the cost and duration of training required by companies that hire these graduates.

2. Literature Review

2.1 Definition of Employability

The discussion of employability has a very long history. This concept was first proposed by British scholars in the 1950s [16]. Many researchers initially focused on the employability of the lower class (particularly people with physiological or mental disabilities). In the 1970s, the objective of studying employability was to determine how to use policy to achieve employment of all people [16]. Since the late 1990s, studies of employability have become a hot issue, and different studies have defined employability from different perspectives (Table 1).

As shown in Table 1, different studies used different definitions for employability. It is a developing process from obtaining employment to maintaining employment, and then continuing employment to achieving success in the selected occupation. At first, the employability definition was based strictly on the outcome of being employed, which does not consider information about personal factors that strengthen employability [24]. Yorke et al. [6] started to focus on examining the critical personal factors that contribute to the employment result. Thus, more recent definitions of employability include personal factor information such as achievement, knowledge, ability, understanding, and attitude. Yorke [5] proposed that the world economy required the production of a well-educated and well-trained work force by education systems. The knowledge, skills, and attributes that are necessary for an individual to make this contribution are considered 'employability', Morley [25] criticized early definitions and suggested research on employability ignored the inequality factors of the employment market and should address how differences in social class, gender, nationality, and region could also affect employability. Fugate et al. [7] started to introduce

Table 1. Main definitions of employability

Employability's core words	Description	References
Getting and keeping fulfilling work, sustainable employment.	Employability is about being capable of finding and keeping fulfilling work. More comprehensively, employability is the capability to move self-sufficiently within the labour market to realise potential through sustainable employment.	Hillage and Pollard 1998 [17]
Gain or maintain employment.	Employability is the ability to gain or maintain employment.	Finn 2000 [18] Ritchie 2000 [19]
Secure a job, keep that job, and do well in it	Employability skills can be defined as the skills that are needed by job applicants to secure a job, to keep that job, and do well in that job.	Robinson 2000 [20]
Gaining basic employment, maintaining employment, and gaining reemployment when necessary.	The employability refers to individuals' abilities and intention to obtain basic employment, maintain employment, and obtain reemployment when necessary.	Harvey 2001 [21]
Individuals' abilities to obtain and maintain employment and respond to the varying market of human resources.	Employability means a behavioral tendency to respond to the varying market of human resources using certain qualifications or abilities from the perspective of individual behavior.	Heijden 2002 [22]
Active adaptability, allowing identification and realization of career opportunities.	Employability is conceptualized as a form of work-specific active adaptability that enables workers to identify and realize career opportunities.	Fugate et al. 2004 [23]
A set of achievements, skills, understandings, and personal attributes required to gain employment and be successful.	A set of achievements, skills, knowledge, and personal attributes, that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community, and the economy.	Yorke and Knight 2004 [6]
A set of skills, knowledge, and personal attributes to secure and be successful.	A set of skills, knowledge, and personal attributes that make an individual more likely to secure and be successful in their chosen occupation to the benefit of themselves, the workforce, the community, and the economy.	Morel and Neil 2006 [22]

the concept of social capital, suggesting employability refers to the abilities of college students to identify job opportunities and obtain employment when seeking jobs and starting businesses. These skills could include identification of careers, individual adaptability, social capital, and human resources. Zheng [26] proposed employability refers to the ability of undergraduates to achieve their employment ideals, meet social demands, and realize social value in the social life by the development of skills and the acquisition of knowledge. Wen[27]pointed out that employability is a comprehensive ability associated with occupation, rooted in an individual's personal goals, and based on learning ability. For individuals, employability describes an individual's ability to obtain employment, maintain employment, and obtain promotion. Individuals may have relative and different opportunities to obtain employment at any point in time. For organizations, employability should meet the demands for development. Zhu [28] described the employability of college students as the combination of knowledge, skills, and various personal characteristics necessary to successfully obtain a job and maintain or change the job.

Historically, employability has not been uniformly defined and instead is a long-term process. In the horizontal breadth, the employment results include obtaining a job, maintaining a job, continuing employment, or achieving greater success in the selected career. Employability is future-oriented, with a need for adaptability and transitioning to future career market places. Keywords of the definition of employability include abilities, achievements, understanding, attitudes, knowledge, adaptability, and occupational identification, and the basic dimensions include personal factors and social factors. The link of employability to personality theory, as well as the qualitative nature and future orientation of the definitions, presents further challenges to measurement of the concept of employability [3].

2.2 Elements of Employability

As described above, previous definitions have shown that employability is a complex and multidimensional construct involving different broad personal characteristics [3]. This can describe either practical or potential abilities, transferable general abilities or professional unique and specific abilities [29]. Recent studies of higher education have examined the specific content of employability. For instance, the employability structure proposed by Mitchell [30] comprises four dimensions of intelligence, social and interpersonal communication ability, operational and entrepreneurial ability, and multiple-technical ability. The conceptual model of Fugat et al. [7] describes employability as a person-centered, psychosocial construct composed of dimensions of career identity, personal adaptability, and social and human capital. The USEM account of employability is probably the

most well-known and respected model in this field, and was originally described by Yorke et al [6]. USEM is an acronym for four inter-related components of employability: understanding, skills, efficacy beliefs, and meta-cognition. Pool and Sewell [31] developed a practical model of graduate employability (CEDGE), which includes five components of career development learning, experience (work & life), degree subject knowledge, understanding and skill, generic skills, and emotional intelligence. Some studies divided employability into professional qualities and non-professional qualities. Professional qualities include professional knowledge and ability, which are determined by the specific discipline. Non-professional qualities include general abilities and necessary personality traits closely associated with the performance of professional abilities that cannot be developed in particular majors. These are common qualities of the people engaging in different professions. Compared with professional qualities, non-professional qualities tend to have more basic and fundamental characteristics. Ke [32] specifically divided the non-professional qualities of college students into ideological and moral qualities, psychological qualities, ability qualities, and innovative qualities. Gao [33] described the employability of college students as the ability of college students to seek a job and maintain that job after they graduate. Employability comprises four types of factors of professional, basic, unique, and job-seeking abilities.

In addition to dimension establishment, many studies have investigated different stakeholders from different perspectives to establish different detailed employability frameworks (Table 2). These main frameworks of employability share some degree of overlap with some qualities such as communication/ interpersonal skills and teamwork appearing in all lists, however, there is less agreement on other items.

Table 2. Main frameworks of employability in some literature

Andrews and Higson [34] Employer and graduate perspectives: multiple sources	**Itani1 and Srour (2015) [9] Engineering Students' Perceptions**	**Archer and Avison (2008) [35] Employers in the UK.**	**Mansour and Dean (2016) [36] Perceived by Employers and University Faculty in the Fields of HRD**
Professionalism	Education (reputation of degree and university)	Communication skills	Knowing how to learn (KHL)
Reliability	Motivation and need for achievement	* Team-working skills	Communication skills (CS)
The ability to cope with uncertainty	* Teamwork and leadership skills	Integrity	Creativity (C)
The ability to work under pressure	Relevance of education with applied position	Intellectual ability	Problem solving (PS)
The ability to plan and think strategically	Creativity and optimism	Confidence	Interpersonal skills (IS)
* The capability to communicate and interact with others	Communication and writing skills	Character/personality	Leadership (L)
Good written and verbal communication skills;	Internship	Planning and organisational skills	Presentation skills (PSK)
Information and Communication Technology skills	Connections	Literacy (good writing skills)	Use of technology (UT)
Creativity and self-confidence	Cumulative average (GPA)	Numeracy (good with numbers)	* Ability to function as part of a team (AFPT)
Good self-management and time-management skills	Risk-taking propensity	Analysis and decision-making skills	Strategic planning (SP)
A willingness to learn and accept responsibility	Extracurricular activities		Managing customers (MC)
	Gender and physical appearance		Change management (CM)
			Communication in foreign languages (CFL)
			Digital competency (DC)
			Cultural awareness and expression (CAE)
			Initiative and enterprise (IE)
			Planning and organization (PO)
			Self-management (SM)

Comprehensive analysis of the literature on employability shows that there is no uniform idea on the content architecture of employability in the industry, but generally employability is thought to contain at least three aspects of knowledge, skills, and personal attributes. Different stakeholders have different definitions and requirements for employability [3], with some potential overlap of some abilities and characteristics. Different professions may have different requirements for employability. Educational institutions should study and cultivate employability by combining the characteristics of various majors and industrial demands. Van Loo [37] proposed including abilities that are horizontally associated with the major and abilities that are longitudinally associated with the occupation, rather than a specific working ability. Jia et al. [38] pointed out that it may be difficult to describe consistent professional abilities due to differences of industry practices and educational goals.

2.3 Employability of Civil Engineering Graduates

With the amalgamation of the world economy and the growing application of information technology, engineering work has significantly changed to require much more than technical expertise acquired in university training and by experience [9]. Teachers in the engineering discipline have started to think about improving students' employability to meet the requirements of employers for engineers in the new era. This builds on the idea that a global engineer is no longer merely a technical person but a professional team player with high technical expertise [39]. Feedback from employers in Australia suggested that graduates lack appreciation of fundamental knowledge, raising the possibility that current engineering courses are misaligned with industry needs. Graduates themselves have acknowledged these weaknesses [40]. Domal and Trevelyan [41] found in their survey of the daily work of engineers that a typical day for an engineer entirely depends on the needs of the client. However, some common elements were identified in the work of all participants, with engineers performing a wide range of job-related activities on a daily basis. Itanil and Srour [9] studied the cognition of soft competence in engineering students from three dimensions. Three main classes of factors can be summarized as personal attributes and nontechnical skills (e.g., creativity and optimism, teamwork and leadership skills, motivation and need for achievement, risk-taking propensity, extracurricular activities, communication and writing skills), educational performance (reputation of degree and university, cumulative average, relevance of education to applied position), and identity (including gender and physical appearance).

The ASCE (American Society of Civil Engineers) has developed a set of learning outcomes for future civil engineers and has made additions to the body of knowledge (BOK). The added BOK criteria stresses nontechnical content related to management and leadership [42]. As explained by Cordero and Farris [43], management skills are not only required of managers. Even technical personnel who perform administrative tasks require management and leadership skills to perform their daily functions. Additionally, many engineers actually assume managerial positions later in their careers.

Since 2005, China has started to establish a certification system for the engineering education major and conducted certification of the engineering major based on the ABET (American Board for Engineering and Technology) requirements. On June 2, 2016, the International Engineering Union Assembly unanimously agreed that China could become a formal member of the Washington Accord (a multilateral agreement between bodies responsible for accreditation or recognition of tertiary-level engineering qualifications within their jurisdictions who have chosen to work collectively to assist the mobility of professional engineers, https://www.ieagreements.org/accords/washington/). The concept of ABET promotes reform of the major of engineering education in China, where the teachers for the engineering major should rethink and position the cultivation goals and graduation requirements and focus on the employability of students. Thus, China's engineering education certification started late, the teaching staff has not transformed the teaching ideas and modes, and do not fully understand non-technical aspects of employability, so attach insufficient importance to them. There has been limited theoretical research on the employability of Chinese students in engineering, particularly civil engineering.

Despite some efforts of the engineering disciplines to align their curricula with the new ABET requirements, engineering programs are still criticized for emphasizing technical skills while paying insufficient attention to nontechnical skills [44, 41]. Thus, the most effective way to improve the skills required by ABET is an important question facing engineering educators. To answer this question, we should first determine the specific employability of engineering graduates (for example, civil engineering) and identify the abilities they lack most in their career development. Therefore, in this study, the employability of civil engineering graduates was analyzed in detail.

3. Research Methodology

The research methodology of this study included a literature review, semi-structured interviews, questionnaire design and survey, data collection, data analysis, result descriptions, and conclusions, as shown in Fig. 1.

3.1 Determination of Factors Contributing to Employability

To investigate employability, a large amount of data from the literature was compared and analyzed. The results showed that different research has utilized different investigation perspectives and characteristics, with both commonalities and differences in understanding the implications of employability. This study defines the employability of the graduates in civil engineering based on the following characteristics of the civil engineering major: (1) the most common abilities of cooperative, innovative, and communication abilities are included, such as motivation and need for achievement, responsibilities, learning ability, interpersonal communication, adaptive ability (including environmental adaptation), and self-management (including emotional control and time management); (2) some abilities are not included, such as education (reputation of degree and university) and gender and physical appearance. These factors may have certain effects on the initial employment of students but these are not abilities that can be changed by students through learning or abilities that can be improved by colleges and universities through teaching. Accordingly, these characteristics are excluded from the research scope; (3) qualities such as devotion, understanding and leniency, and loyalty are included as personal qualities; and (4) knowledge and skills can be evaluated based on GPA, or specific fields such as mathematical knowledge, humanistic knowledge, computer application ability, or foreign language skills. In consideration of the discipline characteristics, we divided knowledge into general basic knowledge (including mathematical, physical, and chemical knowledge, English ability, computer and information application ability, and humanistic quality knowledge), civil engineering knowledge, and practical skills in civil engineering.

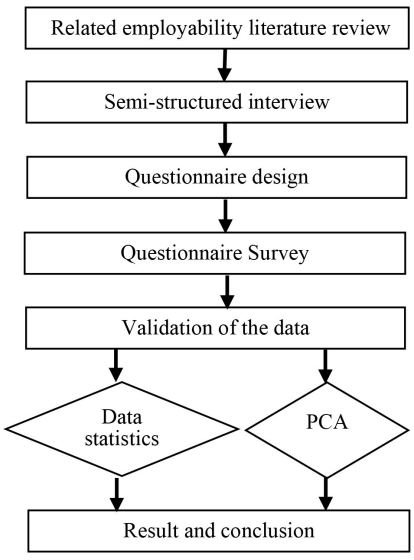

Fig. 1. The research roadmap.

3.2 Semi-Structured Interview

Semi-structured interview questions were conducted to define the factor of employability on the promotion of career. The interviewees included two persons responsible for majors, eight entrepreneurs, and ten graduates. The interviews were completed either face-to-face or by phone. The interviews included three open-ended questions: (1) Which aspects of employability of the civil engineering graduates are the most important and influence career development? (2) Which aspects of training should be enhanced by schools to improve the employability of students? (3) What needed abilities do graduates of civil engineering program lack?

3.3 Design, Testing, and Modification of Questionnaires

Based on literature review and semi-structure interview, a questionnaire was designed to achieve the study objectives. The rights of respondents such as informed consent and freedom of responding was taken into consideration in design of the questionnaire.

The preliminary questionnaire underwent rigorous pilot testing. The questionnaire was presented to two associate professors who are civil engineering faculty at a university in the north of China. Based on their feedback, changes to the wording and layout of the questions were made. Then, 20 graduates from a single university were randomly selected to complete the questionnaire and provide feedback on their understanding of the questions, and provide comments about this questionnaire. These responses from students were used to verify that the understanding of the answers was consistent with the intention of the survey instrument. Based on the test feedback, the questionnaires were again modified. Three variables, i.e. organizing ability, risk-taking propensity, and general knowledge with the lowest scores, were excluded. At last, twelve variables were selected for inclusion as potential factors that could affect career progression (Table 3).

Table 3. Identification of variables affecting student career progression

Variables	Contents
V1	Civil engineering professional knowledge
V2	Innovation and creativity
V3	Practical ability of civil engineering
V4	Career pursuit and motivation
V5	Independent learning capability
V6	Interpersonal skills
V7	Communication skills (including speaking and writing)
V8	Teamwork
V9	Adaptability
V10	Vocational ethics and personal quality
V11	Responsibility

In the finalized questionnaire, the research background, objectives, and contact details were explained in an introductory letter, and the questionnaire included three sections. The first section requests basic information, such as personality information, educational background, and working information, with single questions and multiple choice questions. In the second section, the respondents were asked to rate the scale for the twelve factors influencing employability and career progress using a 5-point scale (1–5). In the last section, the student's views on teaching and management in school were investigated. In addition to closed (choosing a single answer or multiple answers from a list of options) and rating questions, the questionnaire included some open-ended questions and questions that request respondents to give suggestions on the development of the college.

3.4 Distribution of Questionnaires

We applied the questionnaire to a sample of graduates who had studied in the civil engineering program of one university in the north of China between 2006 and 2010, which means that these graduates had completed their university degrees between 2 and 5 years before the time of the survey. The civil engineering of this university is currently trying to align its programs to meet ABET criteria with an eventual plan to seek accreditation. So, this study aimed to check how well the training objectives of civil engineering students were being met, and to understand graduates employability and factors affecting career development.

In May, 2019, we sent an online link to the questionnaires to the 350 civil engineering graduates who had completed their university degrees between 2 and 5 years earlier. The response period was 2 weeks. In this time, a total of 279 responses were received, yielding a response rate of 79%.

4. Data Analysis

It was necessary to subject the raw data to cleaning and filtering to facilitate analysis. This was done using coding and categorization techniques on SPSS25 (IBM). Validation was also performed based on a descriptive statistical analysis.

4.1 Sample Information

The 279 students who responded to the questionnaire included 193 males (69%) and 86 females (31%) (Table 4). The subjects had all obtained their bachelor degree in civil engineering between two and five years earlier. The statistical results of academic records of the samples comply with the characteristics of normal distribution. For the respondents, 9% of the academic records were rated excellent, 30% were rated good, 34% were rated fair, and 27% rated passed. The percentage of female to male graduates in our sampling is almost the same as that of female and male students of the civil engineering major in the university, indicating our samples are reliable.

4.2 Career Development

In the first part of the questionnaire, we used multiple-choice questions to understand the basic information and work of graduates. A total of 226 graduates had obtained a full-time job (81%), five

Table 4. Basic information of statistics samples

Content	Classified statistic	Number	Percentage	Total
Gender	Male	193	69.18	279
	Female	86	30.82	
Time of graduation	2014	66	23	279
	2015	85	30	
	2016	74	26	
	2017	54	20	
Grade Point Average in the university (most grade point is 5.0)	Excellent (4.0∼5.0)	26	9	279
	Good (3.0∼4.0)	84	30	
	Fair (2.0∼3.0)	94	34	
	Up to standard (1.5∼2.0)	75	27	

Table 5. Employment information of samples

Content	Classified statistic	Number	Percentage	Total
Employment situation	Obtain employment (full time)	226	81	279
	Studying for degree (master or doctorate)	46	16.49	
	Self-employed	5	1.79	
	Unemployment	2	0.72	
Degree of correlation between occupation and civil engineering	Closely related	137	59.4	231
	Certain related	66	28.6	
	Unrelated	28	12	
Job position	Junior staff of firm	120	53.1	226
	Middle-level leader in a department	76	33.63	
	Senior managers in a department	7	3.1	
	Middle-level in a firm	21	9.29	
	Senior leader in a firm	2	0.88	
Number of employees	Below 50 persons	35	15	231
	50–100 persons	36	16	
	100–500 persons	50	22	
	500–1000 persons	24	10	
	Over 1000 persons	86	37	
Salary per month (CNY)	3000–5000	87	31	279
	5000–8000	69	25	
	8000–15000	93	33	
	15000–20000	25	9	
	Over 20000	5	2	

students had started their own business (1.79%), two students were unemployed (0.72%), and 46 students (16.49%) were studying for a higher academic degree (master or doctorate) (Table 5), which indicated that the civil engineering graduates had a good employment rate. According to the MYCOS Report on Employment of Undergraduates in China (2018), the employment rate of engineering students is 93%, and the correlation between work and major is 71%. In our study, of the 231 graduates who are currently working, 203 (88%) respondents were working in the civil engineering field and 28 (12%) respondents were working in a position unrelated with civil engineering; this indicated that the students have a strong professional self-identity, a high major match rate, and good career prospects. Of the 226 employed graduates, 47% of the graduates were working in companies with more than 500 employees. This suggested that roughly half of graduates enter large engineering corporations with a high volume of engineering business both at home and abroad, with have large development space. Finally, in terms of salary, 69% of the graduates had a salary higher than 5000 RMB, higher than the average salary of undergraduates who graduated in 2017 in China, 4317 RMB (2018 MYCOS Report on Employment of Undergraduates in China).

We also assessed the satisfaction of graduates with their occupations (Table 6). Using the five-grade scale investigation of the degree of satisfaction with employment, most students were highly satisfied with their work and positions (95%), as well as work environments and conditions. Students were not highly satisfied with their salaries and benefits (the percentages of students who are not satisfied or extremely unsatisfied totaled 12.91%), or with occupation development (the percentages of students who are dissatisfied and very dissatisfied totaled 11.47%). This indicates that the civil engineering students have a high professional self-identity. In addition, their salary level is

Table 6. Satisfaction statistics of graduates on career development

Items	Degrees of satisfaction				
	Very satisfied	More satisfied	Basic satisfied	Dissatisfied	Very dissatisfied
Work contents and positions	18.28%	42.29%	34.77%	3.94%	0.72%
Salary and benefits	13.26%	35.13%	38.71%	12.19%	0.72%
Work environments and conditions	16.49%	38.35%	35.48%	7.89%	1.79%
Career development levels and speed	13.98%	31.9%	42.65%	10.39%	1.08%

higher than the average level but the civil engineering graduates also have higher labor intensity and more difficult working conditions compared with graduates in other majors. Their work efforts should lead to higher salaries. Most graduates are unsatisfied with their career development. This suggests graduates still lack some career development abilities in their career, which influences the improvement in their work efficiency.

4.3 Reliability Analysis and Consistency Test

We conducted an initial reliability test to examine the reliability, consistency, and stability of our data based on the Cronbach's alpha value. The Cronbach's alpha value of the data was 0.930 and the Cronbach's Alpha after standardization of the data was 0.934 (Table 7), which indicates very strong data reliability. Using a general attitude or psychological perception scale, a value higher than 0.9 indicates that the reliability of rating scale is very high [45].

The ratio of sample size to the number of variables in this study was 23.2, higher than the threshold ratio of 5.00 recommended by Gorsuch [46]. Thus, the sample size was large enough for Exploratory Factor Analysis (EFA). The Kaiser–Meyer–Olkin (KMO) value was 0.907 (Table 8), suggesting a high degree of common variance among the variables. The value of the test statistic (chi-square for Bartlett's sphericity) was 894.887) and the p-value was $0.000 < 0.01$, suggesting that the population correlation matrix was not an identity matrix and therefore, the data collected were appropriate for EFA.

The mean difference among items was small, between 4.15 and 4.64, and the variance ranged from 0.343 to 0.689 (Table 9). The highest grade mean is communication skills (4.64), indicating that the ability of communication is most importance for graduates. The mean variance of the 12 included items was only 0.346, and no extreme questions were found.

4.4 Exploratory Factor Analysis

EFA is usually used to identify a small and manageable set of underlying (i.e., latent) factors that can be used to represent correlations among a large set of interrelated variables. Two essential stages are involved in EFA, factor extraction and factor rotation, and EFA can be used as a precursor to latent variable modeling or confirmatory factor analysis (CFA) [47]. Here, EFA was adopted to explore the underlying factors among the 12 variables.

Table 7. Reliability statistics

Cronbach's Alpha	Cronbach's Alpha based on Standardized items	N of items
0.930	0.934	12

Table 8. KMO and Bartlett's test

The Kaiser–Meyer–Olkin (KMO) of sampling adequacy		0.907
Bartlett's Test sphericity	Approx.chi-square	894.887
	Freedom	66
	p-value	0.000

Table 9. Description Statistics for Measurement Items

Description	N	Mean	Standard deviation	Variance
Responsibility (serious and responsible during working)	279	4.59	0.618	0.382
Career pursuit and motivation	279	4.54	0.658	0.432
Civil engineering professional knowledge	279	4.41	0.721	0.520
Vocational ethics and personal quality	279	4.51	0.686	0.470
Practical ability of civil engineering	279	4.36	0.735	0.540
Independent learning capability	279	4.58	0.648	0.420
Interpersonal skills	279	4.62	0.588	0.345
Teamwork spirit	279	4.55	0.657	0.431
Communication skills (include speaking and writing)	279	4.64	0.585	0.343
Innovation and creativity	279	4.15	0.830	0.689
Adaptability	279	4.53	0.669	0.448
Self-management skill	279	4.58	0.614	0.377
Number of valid individual cases	279			

Table 10. Rotated factor matrix for Measurement Items

No.	Items	Factors		
		1	2	3
1	Communication skills (including speaking and writing)	0.788	0.081	0.101
2	Interpersonal skills	0.632	0.273	0.245
3	Adaptability	0.608	0.360	0.185
4	Self-management skill	0.596	0.467	0.099
5	Vocational ethics and personal quality	0.110	0.786	0.106
6	Independent learning capability	0.355	0.578	0.191
7	Career pursuit and motivation,	0.338	0.577	0.159
8	Responsibility	0.487	0.503	–0.020
9	Teamwork	0.274	0.469	0.374
10	Practical ability of civil engineering	0.140	0.056	0.768
11	Civil engineering professional knowledge	0.376	0.057	0.694
12	Innovation and creativity	–0.116	0.408	0.635

Note: extraction method: principal component analysis; rotation method: Caesar normalization maximum variance method. Rotation converged after seven iterations.

For factor extraction, principal component analysis (PCA) was used to identify underlying factors. To determine the number of factors to be extracted, Horn's parallel analysis [48] was adopted, because this approach has been recognized as the most accurate way to determine the number of factors to retain [49–50]. As a result, loadings of small magnitude approached zero but large loadings remain significant. In this study, oblique rotation was applied because in almost all areas of social science, any factor is more or less related to other factors, and arbitrarily forcing the factors to be orthogonal would introduce bias [51, 52].

When PCA with promax rotation was performed, the result indicated three factors with eigenvalues over 1. These three eigenvalues were then compared with the criterion values from the parallel analysis program developed by Patil et al. [53]. The number of components that should be retained is the number of eigenvalues larger than the corresponding random eigenvalues (i.e., criterion values). The result showed a three-component solution (Table 10).

The three factors extracted via EFA were interpreted as vocational quality, vocational development potential, and professional skill. These three components explained 55.39% of the total variance (Table 11).

4.5 PCA Results

4.5.1 Factor 1: Vocational Quality

The most important ability factor accounts for 38.66% of the total variance. We call this factor "vocational quality," and includes V1 (communication skills, which include speaking and writing), V2 (interpersonal skills), V3 (adaptability), and V4 (self-management skills). The data showed that the civil engineering graduates who have been working

Table 11. Interpretation of total variance

Component	Initial characteristic value			Sum of squares of load extracted			Sum of squares of load rotated total
	Total	Variance percentage	Accumulative %	Total	Variance percentage	Accumulative %	
1	4.639	38.662	38.662	4.639	38.662	38.662	2.484
2	1.173	9.772	48.434	1.173	9.772	48.434	2.361
3	0.834	6.952	55.386	0.834	6.952	55.386	1.802
4	0.777	6.479	61.864				
5	0.752	6.265	68.129				
6	0.657	5.472	73.601				
7	0.622	5.184	78.785				
8	0.578	4.818	83.603				
9	0.556	4.629	88.232				
10	0.521	4.338	92.570				
11	0.496	4.134	96.704				
12	0.396	3.296	100.000				

for many years consider communication ability, interpersonal communication ability, self-control management ability, and adaptive ability as the most important occupational abilities. This suggests that the cultivation of students' occupational qualities should be strengthened should be a focus of teaching in the civil engineering discipline. This result change the traditional impression of engineering education in all sectors of society in China. Traditionally, the most important quality of students is strong professional ability in the engineering application discipline. Chinese students are required to acquire high levels of knowledge of natural sciences such as mathematical, physical, and chemical science from an early age. At the college level, additional emphasis was placed on imparting professional knowledge with insufficient cultivation of soft abilities.

4.5.2 Factor 2: Vocational Development Potential

The total variance of the second factor, development potential, accounts for 9.78%. The career development potential is a potential ability that facilitates occupational transformation, transfer, and promotion during a certain period. It comprises five factors: vocational ethics and personal quality, independent learning capability, career pursuit and motivation, responsibility and teamwork. The significance of these factors verifies the result of the interviews with employers. In the interviews, employers indicated that they would first consider individuals with good qualities (such as loyal, dedicated, and inclusive) when they planned to promote someone, because they consider people with these qualities deserving of trust. Employees should also be studious, strive to make progress, and be willing to learn all their life, as this continuous improvement is the basis for the development of a person's career. Tan [54] proposed that in addition to human resources capital, social capital, and dynamic characteristics, the concept of employability should also include life-long learning, because the knowledge and ability acquired during higher education are insufficient to allow adaptation for a successful career. Thus, life-long learning should also be an internal factor of the employability of college students. Finally, career pursuit and driving force serve as the foundation of career development. A person with intelligence and wisdom and good qualities would be unable to bear great responsibilities in a career without occupational ambition or driving force. The occupational potential factor includes valuable personality characteristics. These people are not content with the status quo, but are self-motivated to pursue a career, so continue to learn and progress.

4.5.3 Factor 3: Professional Skills

The third factor influencing the career development of the professional ability of civil engineering graduates accounted for 6.95%. This factor includes civil engineering knowledge, practical ability in civil engineering, and innovation and creativity. The civil engineering major is an engineering application discipline. Only graduates with solid professional knowledge and professional practical skills (including skills such as design, computation, measuring, and drawing) can serve as engineers or engage in related management work in the field of civil engineering. Based on the investigation, the graduates think that in addition to professional knowledge and professional practical ability, innovative ability is an important skill for successful employment, suggesting that the engineering field requires innovative talents to effectively adapt to or drive the development for professional success.

5. Discussion

5.1 Summary

The factors of employability vary by major. Colleges and universities should understand the current employment situation of their graduates and accurately define employability in particular disciplines to set cultivation goals. Thus, our study investigated the employment situation of the graduates. Overall, our data showed that the civil engineering graduates have a high major matching rate between their work and major, where 88% of the graduates work in fields associated with civil engineering with salaries that are higher than the average salary in China. These results indicate a strong market demand for civil engineering graduates, this coincides with the current strong development of the in civil engineering construction business in China. Additionally, these graduates have strong professional self-identity. With the increasing globalization of the economy, China's construction enterprises are vigorously conducting international construction engineering business, which supports the development of the civil engineering profession and employment of graduates. Investigation of the satisfaction degree of graduates revealed a high degree of satisfaction of these respondents with their current posts and work environments, but a low degree of satisfaction with their salary and career development, which may be associated with the hardship of their occupation. Enterprises should consider establishment of a more rational salary system or benefit system to improve the subjective well-being of staff members.

In this study, a framework of civil engineering employability was built, which include 12 most

important employability elements. This points out the direction for the establishment of professional training objectives of civil engineering, which has important reference for civil engineering majors in other regions and countries.12 variables that affect graduate employability were retained and consolidated into three factors, which were confirmed as significant by the CFA results. They were interpreted as vocational quality, vocational development potential, and professional ability, vocational qualities are the most important employability factor that influences graduates. This result could provide enlightenment for the teaching reform of civil engineering in the future.

Vocational qualities is comprised of communication and expression ability, interpersonal communication ability, adaptive ability, and management ability. This indicates that general employability factors are also important for students in occupation-oriented disciplines, a result that is consistent with the work of Archer and Davison [34], in their investigation of the capacity of most satisfaction of employers for employees, the social skill rank 16th, suggesting significant room for improvement to meet employers needs. Communication ability and social ability are also considered to be important factors of employability in the mechanical manufacturing profession [55]. Overall, we should modify teaching goals, change the assessment methods, and include additional teaching activities by incorporating reports, speeches, and teamwork cooperation as part of the coursework. Those efforts do not negate the requirement for skills such as communication and teamwork in most engineering courses instead of only in specific electives. This would provide opportunities for students to acquire these skills for later use [9]. A more specific approach is to develop problem-based learning in the curriculum, this could help students to link theory to practical application in a local context. At the same time, they are able to exercise several skills, such as problem-solving, communication, information management, group effectiveness and interpersonal skills [56, 57].

Development potential is the employability that influences the consistent development of a graduate's career, and is comprised of five factors, professional spirit and personal qualities, self-learning ability, and career pursuit or motivation, responsibility and teamwork. First, understanding development potential requires us to cultivate students' self-learning ability. With good self-learning ability, many students are able to learn; after students have self-learning ability, many other abilities can be acquired by their self-learning, for example, computer information technology, a foreign language, and different ways of thinking. Students are encouraged to actively learn to acquire knowledge rather than rely on the instruction of teachers. The combination of self-learning ability and career pursuit is the manifestation of a positive personality. Many studies have linked proactive personality traits and career success [3].Second, Cultivation of these skills requires transformation from a teaching-oriented mode to a learning-oriented mode, emphasis should be placed on the shaping of the personal qualities of students. In teamwork and other learning activities, evaluation of students' qualities can be included as part of the assessment. The assessment mode can be a combination of grading by teachers and grading by students. For example, this may include evaluation of honesty, being inclusive, emotionally stable, responsibility or the level of dedication. By emphasizing the importance of these traits, students can learn to be more valued and respected employees. Woods and West tell us that managers are often looking for personality as well as skills, saying they want employees who are reliable, dependable, able to work under pressure, creative, and enthusiastic. These traits are personality characteristics [57]. Career pursuit and development motivation should be properly guided based on studies of employment and psychology.

The professional ability comprises three variables of practical ability of civil engineering, professional knowledge of civil engineering, and Creativity. This indicates that professional ability is important for the development of student careers. The survey samples this paper is the graduates 2–5 years after graduation, at this time, the graduates do not seek to obtain a job, but have relatively fixed jobs, and their cognition for employability is mainly based on the requirement of career development. They think that professional ability is an important factor affecting employability in the engineering profession. This shows that in the field of civil engineering, professional ability will always affect their career development, which includes good professional knowledge of civil engineering, practical ability of engineering design, calculation, management, and innovation ability. Thus, teachers of the civil engineering discipline should cultivate technical ability in addition to non-technical ability. The students most valued engineering practical application ability, which is consistent with the investigation result of the open question. In the questionnaires, we asked students to comment on the teaching of civil engineering, the most common suggestion was to strengthen practical training. Students should be offered more opportunities to work in companies to enhance their practical ability. This experience should allow them to adapt to new jobs faster after starting to work at a company. China's engineering universities are attempting to reform

teaching, strengthen the links between schools and businesses, and ask the students to develop skills by working in companies. Innovative and creative abilities are also important factors contributing to students' employability, this result is consistent with the research results of other regions on the employability of civil engineering. Wang [15] showed that many engineering tasks require the engineer to employ great creativity to come up with imaginative and innovative projects to solve challenging problems, and Itani et al.'s investigation for students of civil engineer also verified this [9]; but Nugraha [55] did not involve creativity in the study of the professional employability of mechanical engineering. In the field of civil engineering, significant developments has occurred in BIM technology, 3D technology, and assembly engineering, and companies need employees with civil engineering skills, innovative ideas, and knowledge of new forms of technology to increase profit for companies. With the promotion of engineering certification, there is a growing emphasis on the cultivation of students' innovative ability in colleges and universities in China.

5.2 Limitation and Future Study

In this study, the graduates of one particular discipline were selected as the research subjects, it could provide a model for studies of employability in other disciplines, and also provides reference for personnel training of civil engineering or other engineering disciplines in other regions, but the implications of employability will also necessarily vary depending on the labor market demand. This means that study of employability is a dynamic process, which require a constant tracking process. Different posts and positions may differ in employability criteria. Our studies conducted based on educational institutions may not consider the effects of social capital factor or social relations such as gender, nationality, or family status on employability. Further studies should explore the influence of social capital on the employability of civil engineering graduates, and determine the best strategies to implement innovative ideas for the teaching of civil engineering.

6. Conclusions

This study investigated graduates in civil engineering. Civil engineering students have a promising employment rate of 88% and an average salary that is higher than the average salary of graduates of other majors. Based on previous studies and the students' questionnaire test, 12 frameworks of civil engineering employability were constructed. By the analysis of factors, this study determined that three major factors influence the employability of graduates in civil engineering: vocational qualities, development potential, and professional ability. This result defines the most important determinant of the employability of the graduates in civil engineering is the acquisition of basic occupational qualities. These qualities are critical for all industries and are necessary conditions for a person to obtain and maintain a job. A person's internal development motivation and self-learning ability are internal driving forces of career development, excellent personality traits are preconditions for career development. Professional ability is also a manifestation of the knowledge factor. Graduates value professional practical ability and professional knowledge. In addition, innovative thinking and ability are required for employment ability, and should be part of the teaching process.

These results indicate potential future directions for civil engineering programs. First, the cultivation of basic skills such as communication, management, and adaptation, should be included in various types of courses. It is necessary to revise the professional training objectives and curriculum training objectives to include the contents of non-technical ability. Secondly, teaching-oriented mode should be changed. Instead, teachers should focus on ability rather than knowledge, turn knowledge class into ability class. Task-oriented, project-oriented, and flipped-class models should be used to increase students' abilities to self-learn. In team work, the teacher should cultivate students' personal qualities and professional spirit through a problem-based learning approach The assessment mode should be transformed from teacher assessment to mutual group rating or self-assessment to cultivate student skills. Finally, colleges and universities should guarantee the improvement of professional ability, including professional practical ability; strengthen cooperation between schools and companies; and offer more opportunities for professional practice during education to allow the students to more fully understand the demands of industry meanwhile focusing on the development of the basic skills. Colleges and universities should focus on industrial scientific and technological development of the industry, cultivate students' innovative thinking and ability in the teaching process, and be sure that the curriculum meets the changing needs of industry.

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References

1. L. Holmes, Competing perspectives on graduate employability: Possession, position or process? *Studies in Higher Education*, **38**(4), pp. 538–554, 2013.
2. L. Harvey, An employability performance indicator?, *Perspectives*, **4**(4), pp. 105–109, 2000.
3. A. Tymon, The student perspective on employability, *Studies in Higher Education*, **38**(6), pp. 841–856, 2013.
4. M. Branine, Graduate recruitment and selection in the UK: A study of recent changes in methods and expectations, *Career Development International*, **13**(6), pp. 497–513, 2008.
5. M. Yorke, *Employability in Higher Education: What Is It-What Is It Not*, York: Higher Education Academy, York, pp. 23–31, 2006.
6. M. Yorke and P. Knight, *Embedding employability in the curriculum, Learning and Employability Guides*, York: Higher Education Academy, York, pp. 10–12, 2004.
7. M. Fugate, A. J. Kinicki and B. E. Ashforth, Employability: A psycho-social construct, its dimensions, and applications, *Journal of Vocational Behavior*, **65**(1), pp. 14–38, 2004.
8. V. Gonzalez-Roma and J. P. Gamboa, University graduates employability, employment status, and job quality, *Journal of Career Development*, **45**(2), pp.132–149, 2018.
9. M. Itanil and I. Srour, Engineering students perceptions of soft skills, industry expectations, and career aspirations, *Journal of Professional Issues in Engineering Education and Practice*, **142**(1), pp. 040150052–5, 2016.
10. A. Rothwell, I. Herbert and F. Rothwell, Self-perceived employability: construction and initial validation of a scale for university students, *Journal of Vocational Behaviour*, **73**(1), pp. 1–12, 2008.
11. M. Tomlinson, The degree is not enough: Students' perceptions of the role of higher education credentials for graduate work and employability, *British Journal of Sociology of Education*, **29**(1), pp. 49–61, 2008.
12. D. Rae, Connecting enterprise and graduate employability: challenges to the higher education culture and curriculum? *Education Training*, **49**(9), pp. 605–19, 2007.
13. K. Purcell, *Qualifications and careers: equal opportunities among graduates*, Working Paper Series (Employment Studies Research Unit, University of the West of England), 2002.
14. P. Scott, *The meanings of mass higher education: the society for research into higher education & open university*, Milton Keynes, pp. 10–15, 1995.
15. H. H. Wang, S. C. Kang and T. K. Lee, Cultivating Imagination in Entry-Level Civil Engineering Students: Exploring the Effects of an Innovative Instructional Model, *International Journal of Engineering Education*, **29**(5), pp. 1–12, 2013.
16. Y. L. Cui, A review of researches and analysis of problems on college students' employability at China and abroad, *Hei Longjiang Researches on Higher Education*, **l**(7), pp. 1003–2614, 2011.
17. J. Hillage and E. Pollard, *Employability: developing a framework for policy analysis*, Department for Education and Employment (DFEE) Research Report no RR85, London, 1998.
18. D. Finn, From full employment to employability: a new deal for Britain's unemployed? *International Journal of Manpower*, **21**(5), pp. 384–399, 2000.
19. J. Ritchie, New deal for young people: Participants perspectives, *Policy Studies*, **21**(4), pp. 301–312, 2000.
20. J. P. Robinson, What are employability skills, *Workplace*, **1**(3), pp. 1–3, 2000.
21. L. Harvey, Defining and measuring employability, *Quality in Higher Education*, **7**(2), pp. 97–109, 2001.
22. I. J. M. Beatrice and Van der Heijden, Individual career initiatives and their influence upon professional expertise development throughout the career, *International Journal of Training and Development*, **6**(2), pp. 54–79, 2002.
23. N. Moreland, Entrepreneurship and higher education: an employability perspective, Higher Education Academy, York, England, pp. 10–16, 2006.
24. S. McArdle, L. Waters, J. P. Briscoe and D. T. Hall, Employability during unemployment: Adaptability, career identity and human and social capital, *Journal of Vocational Behavior*, **71**(2), pp. 247–264, 2007.
25. L. Morley. Producing new workers: Quality, equality and employability in higher education, *Quality in Higher Education*, **7**(2), pp. 131–138, 2001.
26. X. M. Zheng, Theory of employability, *Journal of China Youth University for Political Sciences*, **21**(3), pp. 91–93, 2002.
27. S. B. Wen, A research on the development strategies of graduate employability and the cultivation of talents, *Modern University Education*, **1**(1), pp. 101–108, 2006.
28. X. C. Zhu, On the cultivation of college student's employability, *Higher Education Exploration*, (4), pp. 124–127, 2009.
29. G. C. Yan, Reflection about talents cultivating system based on college graduates' competence, *China Higher Education Research*, (11), pp. 18–23, 2016.
30. A. G. Mitchell, Strategic training partnerships between the state and enterprises, *International Labour Organization*, 1998.
31. D. Pool, L. Sewell and P. John, The Key to employability: developing a practical model of graduate employability, *Education Training*, **49**(4), pp. 277–29, 2007.
32. Y. Ke, The influence of non-professional quality on the employment quality of college students, *Journal of Study on Youth of China*, (7), pp. 98–101, 2010.
33. Y. W. Gao, Analysis of the employability of college student, *Higher Education Research*, (15), pp. 73–75, 2009.
34. J. Andrews and H. Higson, Graduate Employability, soft skills versus hard business knowledge: A European study, *Higher Education in Europe*, **33**(4), pp. 411–422, 2008.
35. W. Archer and J. Davison, *Graduate employability: What do employers think and want?*, The Council for Industry and Higher Education, London, pp. 8–20, 2008.
36. B. E. Mansour and J. C. Dean, Employability kills as perceived by employers and university faculty in the fields of human resource development (HRD) for entry level graduate jobs, *Journal of Human Resource and Sustainability Studies, SciRes*, (4), pp. 39–49, 2016.
37. J. V. Loo and J. Semeijn, Defining and measuring competences: an application to graduate surveys, *Quality & Quantity*, (38), pp. 331–349, 2004.
38. L. J. Jia and Y. Xu, Psychological analysis of college students employability, *Social Sciences Nanjing*, (10), pp. 129–133, 2006.

39. E. F. Redish and K. A. Smith, Looking beyond content: skill development for engineers, *Journal of Engineering Education*, **10**(1), pp. 295–307, 2008.
40. R. Martin, B. Maytham, J. Case and D. Fraser, Engineering graduates' perceptions of how well they were prepared for work in industry, *European Journal of Engineering Education*, **30**(2), pp. 167–180, 2015.
41. V. Domal and J. Trevelyan, An engineer's typical day: lessons learned and implications for engineering education, Conference for the Australasian Association for Engineering Education, Engineering the Curriculum. Barton, A.C.T.: Engineers Australia, Aug (20), pp. 637–643, 2009.
42. T. Siller, A. Rosales, J. Haines and A. Benally, Development of undergraduate students professional skills, *Journal of Professional Issues in Engineering Education and Practice*, **135**(3), pp. 102–108, 2009.
43. R. Cordero and G. F. Farris, Administrative activity and the managerial development of technical professionals, *Ieee Transactions on Engineering Management*, **39**(3), pp. 270–276, 1992.
44. J. Gilleard and J. D. Gilleard, Developing cross-cultural communication skills, *Journal of Professional Issues in Engineering Education and Practice*, **128**(4), pp. 187–200, 2002.
45. X. Wei, *SPSS Statistical analysis method and application*, Electronic Industry Press, p. 366, 2005.
46. R. L. Gorsuch, N. J. Hillsdale, E. J. Gosman, B. A. Dandridge, M. T. Nettles and A. R. Thoeny, Predicting student progression: The influence of race and other student and institutional characteristics on college student performance, *Research in Higher Education*, **18**(4), pp. 209–236, 1983.
47. C. DiStefano, M. Zhu and D. Mindrila, Understanding and using factor scores: considerations for the applied researcher, *Practical Assessment, Research, and Evaluation*, (14), pp. 1–11, 2009.
48. J. L. Horn, A rationale and test for the number of factors in factor analysis, *Psychometrika*, (32), pp. 179–185, 2009.
49. J. C. Hayton, D. G. Allen and V. Scarpello, Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis, *Organizational Research Methods*, **7**(2), pp. 191–205, 2004.
50. J. Pallant and M. Maidenhead, SPSS survival manual: a step by step guide to data analysis using SPSS, U.K, 2010.
51. M. Matsunaga, How to factor-analyze your data right: Do's, don'ts, and how-to's, *International Journal of Psychological Research*, **3**(1), pp. 97–110, 2010.
52. X. Zhao, B. G. Hwang, S. P. Low and P. Wu, Reducing hindrances to enterprise risk management implementation in construction firms, *Journal of Construction Engineering and Management*, **141**(3), pp. 04014083, 2015.
53. V. H. Patil, S. N. Singh, S. Mishra and D. T. Donavan, Parallel analysis engine to aid determining number of factors to retain, Computer software, http:// smishra.faculty.ku.edu/parallelengine.htm, Accessed 1 July 2007.
54. Z. Tan, An analysis on the concept of the employability of college students, *Jiangsu High Education*, (4), pp. 81–83, 2010.
55. H. D. Nugraha, A. Djohar and M. Komaro, Employability skills framework for mechanical engineering, *Advances in Social Science, Education and Humanities Research*, **299**(1), pp. 183–188, 2019.
56. M. B. Mgangira, Integrating the development of employability skills into a civil engineering core subject through a problem-based learning approach, *International Journal of Engineering Education*, **19**(5), pp. 75–761, 2003.
57. B. Bender and J. Longmu, Knowledge management in problem-based educational engineering design projects, *International Journal of Engineering Education*, **19**(5), pp. 706–711, 2003.
58. S. Woods, M. Yorke and M. West, The psychology of work and organizations, employability in the undergraduate curriculum: Some student perspectives, *European Journal of Education*, **39**(4), pp. 409–27, 2010.

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