

# A Progressive Web App for Evaluating Occupation Indicator

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## Abstract

Shortening the education-to-employment gap is an urgent priority for higher education in Taiwan. However, the process is comprehensive. From curriculum analysis, the academic institutions find out industry needs and build basic and core competencies. They assign these competencies to various courses during curriculum planning/development. Eventually, they evaluate the results using competence indicator or curriculum map to determine if the student has met the core competency requirements. For students, how to get the results easily and quickly is what they care about. This study proposes a progressive web app (PWA) emphasizing user experiences to provide students with a convenient way to obtain the results of core competency assessments. This application also suggests taking related courses and obtaining certificates to prevent students from taking irrelevant courses and miss opportunities to improve their employability.

**Keywords:** Education-to-employment gap, Occupation indicator, Employability, Model-view-controller, Progressive Web App

## 1 Introduction

In a globalization environment, the industries request students with technological education to meet the competency demands of the workplace when they seek employment. Technological education should be focused on the training of key competencies and problem-solving abilities. Industry-oriented competencies refer to the ability to obtain and keep a job; therefore, the priority of education should be the development of industry-oriented competencies [1-3]. Unfortunately, the Council for Economic Planning and Development (CPED), Executive Yuan, Taiwan, also points out that the graduates from technological departments (such as electrical, electronics, telecommunications, information engineering and information management) do not have the skills to meet these industry requirements [4-5].

The education institutes try to reconstruct and refine the technological curricula. The process of curriculum

development contains several steps such as problem identification and general needs assessment, targeted needs assessment, goals and objectives, educational strategies, implementation, and evaluation and feedback [6]. Some research considered the development steps as planning, content, and implementation [7]. Usually, the final step of curriculum development is to evaluate the outcomes after curriculum implementation. However, it is designed from the perspective of the instructors not from the students. This paper adds an additional step called delivery to provide convenient and friendly user interface to view the outcomes for the students. It adopts progressive web app (PWA) technology to provide reliable, fast, and engaging user experiences [8].

The remainder of this paper is organized as follows. Section 2 describes the related works about definition, accreditation, and evaluation of technological competence, and PWA development. Section 3 explains the system architecture and the concept of our proposed design. Section 4 will demonstrate the implementation of our proposed solution. Finally, the conclusion of this article is made in section 5.

## 2 Related Work

The below studies elucidates that the technological and vocational education (TVE) in Taiwan how to achieve industry competence objectives through curriculum reform. Based on the manpower requirements of the industries, the skills were used as a guide to recognize the basic and professional competencies in technology fields. The technological institutes merge these competencies into their curricula. Then, the institutes offer engineering technology courses with accreditation for the Institute of Engineering Education Taiwan (IEET) regarding certification criteria. Through curriculum map, the instructors could sum up the student score of the competencies to understand the learning status. Finally, we discuss the emerging web application to deliver the outputs to the students in time.

## 2.1 Definition and Accreditation of Competence

Some studies considered competences as the external behaviors comprising various dimensions of skills, attitude and knowledge [9-12]. These researchers divided the competences in electrical technology industries into basic and professional competence. They considered the basic competence as a critical, comprehensive, all-encompassing and physical ability for survival and living well. It consists of knowledge and skills about personal growth, learning, working and living. However, professional competence is a key factor for completing a task successfully [9, 13].

In Taiwan, the Institute of Engineering Education Taiwan (IEET) is responsible for accrediting and evaluating the engineering and technology education [14]. It provides five types of accreditation: Engineering Accreditation Criteria (EAC), Technology Accreditation Criteria Version (TAC), Computing Accreditation Criteria (CAC), Architecture Accreditation Criteria (AAC) and Design Accreditation Commission (DAC) [15].

## 2.2 Evaluation of Occupation Indicator

Curriculum mapping is a procedure for presenting a

visual representation of a curriculum, based on real time information [16]. A curriculum map is regarded as a road map of a curriculum, guiding users through the various elements of the curriculum and their interconnections. Therefore, constructing a curriculum map is a process of considering when, how, and what is taught, as well as the assessment measures utilized to explain the achievement of expected student learning outcomes [17]. For example, Yi-Lin Liu et al. explored competencies of Nanotechnology comprising conceptual knowledge, procedural knowledge, operational skills, and attitudes. The curriculum mapping consisted of four types of subject content: (1) basic courses, (2) core courses, (3) nano-specific professional courses, and (4) nano-related professional courses [18]. The results of curriculum map analyses by domain and subject content are displayed in Table 1. The largest portion was composed of nano-related professional courses There are one hundred and seven courses and 43.67%. That others were followed by basic courses (26.12%), nano-specific professional courses (18.37%), and core courses (11.84%) at the undergraduate level of nanotechnology. This example demonstrates the relation among professional domain (occupation or job), professional competencies, and courses.

**Table 1.** Analysis of undergraduate curriculum map by domain and subject content

Subject content Domain	Basic course	Core course	NSPC <sup>1</sup>	NRPC <sup>2</sup>	Total (%)
Basic science	60	20	2	31	113 (46.11)
Material science	0	4	14	49	67 (27.35)
Advanced technology	1	0	7	19	27 (11.02)
Resource and environmental science	0	0	1	0	1 (0.41)
Biotechnology	2	0	12	3	17 (6.94)
Management	1	2	5	5	13 (5.31)
Others	0	3	4	0	7(2.86)
Total	64	29	45	107	245
%	26.12	11.84	18.37	43.67	100

Note. <sup>1</sup>NSPC: Nano specific professional course. <sup>2</sup>NRPC: Nano related professional course.

## 2.3 Progressive Web Apps

The need for cross-platform development approaches arises from the incompatibility of today's platforms. The cross-platform development has become more popular [31]. The obvious benefits are not only to reduce the development cost and effort but also to gain a quicker time-to-market [19-20]. There are multiple approaches to cross-platform development. Examples of popular frameworks include Ionic Framework, PhoneGap, React Native and Xamarin [21]. These frameworks also represent three technologically distinctive approaches. The web hybrid approaches are

applied in Ionic and PhoneGap frameworks. These two frameworks adopted Apache Cordova technology as core foundation sponsored by the Apaches Software Foundation. React Native utilizes the interpreted approach not to depend on a web-view. It leverages on a JavaScript interpreter instead of web-based HTML components. The third apache is the cross-compilation such as Xamarin. It compiles C# into native binaries for each supported platform. The former apaches provide the cross-platform development solutions. The following question is how to develop a progressive web application. The Progressive Web Apps (PWAs) are a new technology advocated by Google. The PWAs solve user experiences and user offline use. It

combines the advantages of Web and App such as progressive, reliable, responsive, offline, interactive, installable, and notifiable. These new features allow PWAs to earn a place on the user’s home screen [8, 22-23].

### 3 The Proposed PWA Development Methodology of Mobile/Desktop Application

In this study, the term occupation indicator was used to indicate professional competence indicator. This section explains how to design this proposed PWA application. First, we analyze the relationship and the proportion to the occupation indicator, and user workflow in sub section 3.1. The next sub section 3.2 explain how to design this proposed application including the referenced data, the development components, and architecture.

#### 3.1 The System Analysis

According to subsection 2.3, we expected to train the students to gain the professional competency for obtaining the occupation. Syu and Luo listed four formulas to sum up the score of core competency [24]. The factors of the formulas included the scores and credits of the related curricula. We add the new factor, the professional certificates, into the consideration of occupation indicator shown in Figure 1. That adopts the entity-relation model (ER model) to explain their relation. An occupation (entity) needs (relation) many competencies. On the other hand, the same competency can belong to the different occupations. For example, back-end software developers and database administrators (DBA) both need the database concept.

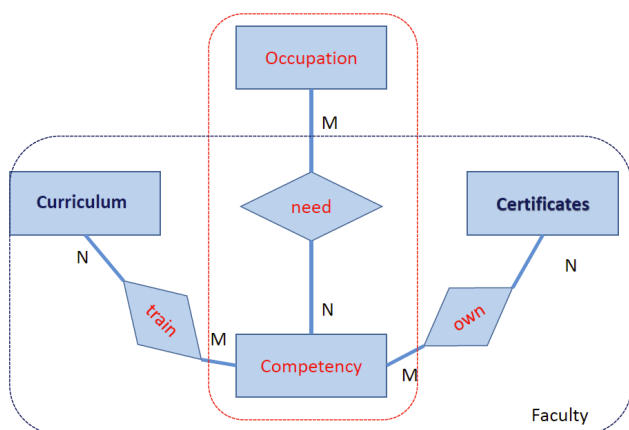


Figure 1. Entity-Relationship diagram among occupation, competency, and curriculum

Figure 2 shows the proportion of occupation indicator. The occupation indicator combines three abilities: foundational ability, inner competitive ability, and outer competitive ability. As Table 1 shown, the nanotechnology (occupation) needs seven competencies and 245 curricula. Foundational ability means rate of

complete for related curricula (245). However, the absolute score of course should not show the real learning situation. It depends on the instructors. We apply the ranking of the course as inner competitive ability. The corresponding certificates are also important index as outer competitive ability. The certificate points depend on the difficulty of the certificate. This application only utilizes one factor for each ability, but it is flexible. The proportion of occupation indicator depends on the user experience.

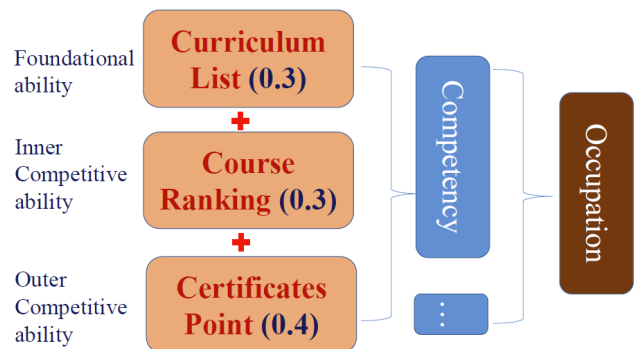


Figure 2. The proportion of occupation indicator

Finally, we depict the user workflow about our proposed application in Figure 3. The student login on this system, which show the list of the related occupation and the score of evaluation. The student can trace his/her favorite occupations and review later. The application will notify the student about the necessary courses for their traced occupations before the start of next semester.

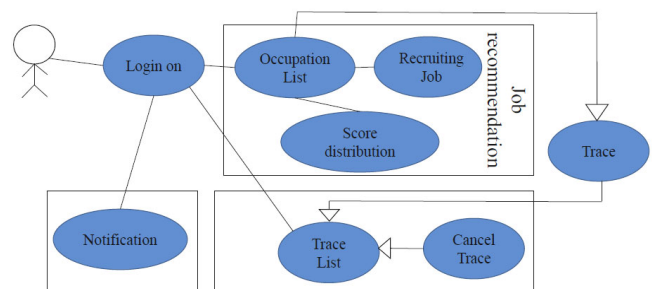


Figure 3. User workflow of the proposed application

#### 3.2 The System Architecture

Table 2 lists the data source for this application. The curriculum program, course score, and corresponding certificates are from the colleges or universities. The latest recruiting jobs are retrieved from web content of job bank such as 104, 1111 or yes123 [25-27].

Table 3 shows the development components consisting of frontend/backend frameworks, and some development and operations (DevOps) tools such as version control systems (VCS) and debug tools. Apache Cordova [28] is an open-source mobile development framework. It allows software programmers to build applications using the common web languages such as JavaScript, hypertext markup

language 5 (HTML5) and cascading style sheets 3 (CSS3), instead of device-specific languages such as Objective-C/Swift of iOS and Java of Android for

cross platform development. Cordova also can use the same code to build PWA or native app [29].

**Table 2.** The summary of referenced data

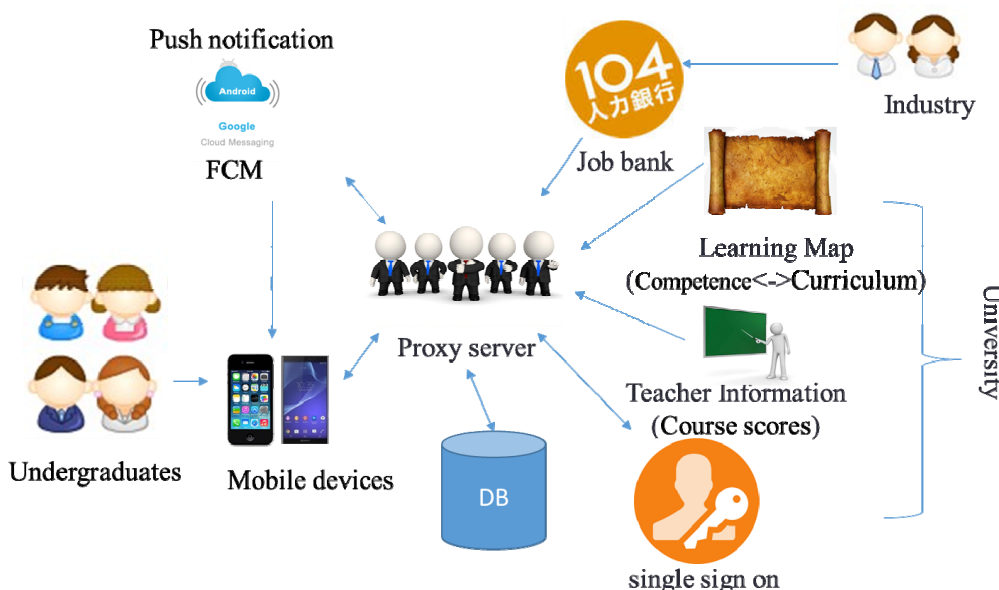
Recruiting Jobs	Input	Job title
	Output	104 job bank, <a href="http://www.104.com.tw/">http://www.104.com.tw/</a>
Curriculum	Input	Department related jobs
	Output	Learning Map, <a href="http://163.15.191.113/">http://163.15.191.113/</a>
Course Score	Input	Teacher account/password
	Output	Teacher Information System, <a href="https://search.kh.usc.edu.tw/TerSystem/login1.htm">https://search.kh.usc.edu.tw/TerSystem/login1.htm</a>
Certificates	Input	Student account/password
	Output	Student E-Portfolio, <a href="http://db.kh.usc.edu.tw/inf/Kali/index.htm">http://db.kh.usc.edu.tw/inf/Kali/index.htm</a>

**Table 3.** The summary of development components

Web Mobile	jQuery Mobile/HTML5	Dynamic web design
	Angular JS	JS MVC framework
HTTP Network debug	Fiddler2	Proxy/Capture network package
	PHP/CodeIgniter MVC	Light-weight PHP MVC framework
Server side (in AWS cloud for scalability)	MySQL	Database
	Apache Web Server	Web server
	Gitlab	Version control service
Co-work tools	Cordova	Mobile cross platform
	Node.js	Install cordova package
	JDK/ Google SDK	Build Android app
	Xcode	Build iOS app

This paper implemented the Representational state transfer (REST) web services as web server using PHP CodeIgniter framework [30]. The REST web services suit any kinds of web browsers and give the software developers flexibility on the different devices such as desktops and smart mobile devices [32-33]. The developers can use asynchronous JavaScript and XML (AJAX) technologies to retrieve data with the JavaScript Object Notation (JSON) format from web server. It also reduces both the amount of data

transmission and client processing like as parsing HTML tags. The system architecture of the proposed PWA application is shown in Figure 4 as below. The proxy server acts as web services, which retrieve data from job bank, learning map, and teacher information system and then put data into local database (DB). It also replies the requests of the undergraduates such as log on via university account, view the occupation indicator or the traced occupations.



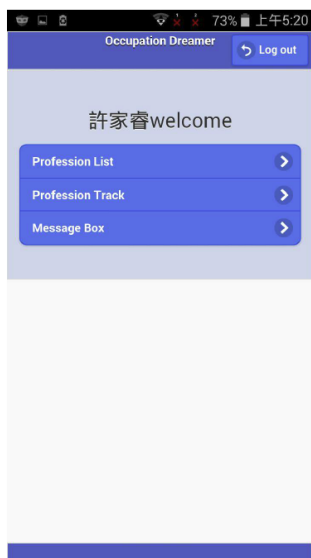
**Figure 4.** System architecture of the proposed PWA application

### 4 Experiment Result

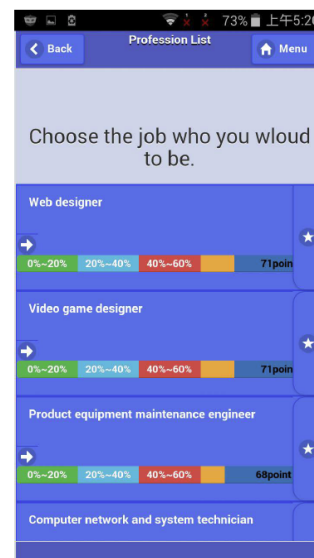
This section demonstrates the prototype of the proposed PWA application. The student inputs the account and password from the university given on a mobile device. The proxy server will forward data to single sign-on (SSO) server to verify. After authentication, the student can use three functions shown in Figure 5(a):

Figure 5(b) contains three parts of each list item. The occupation title, occupation indicator, and track

star are displayed separately on the top, the bottom, and the left of each list item. When the student taps the occupation title, the application will list the latest recruiting jobs retrieving from on-line job banks as shown in Figure 6(a). However, the highest score of occupation indicator does not mean that it is the most interest occupation of the student. Figure 6(b) explores the detailed information of score combination. The student could understand what courses he/she should take in future semesters if he/she want to be a computer network and system technician. Figure 6.c stores the favorite record.



(a) Main screen with three functions after login

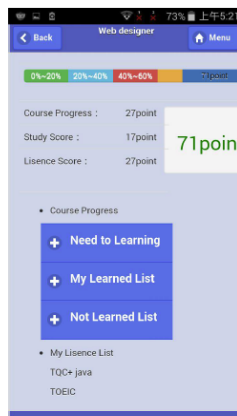


(b) List the corresponding occupations with occupation indicator

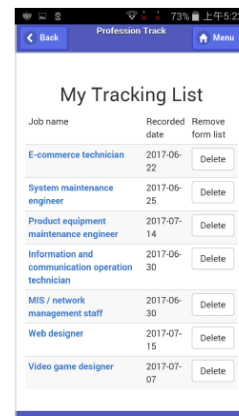
Figure 5.



(a) Job list from job bank



(b) The detailed information about occupation indicator



(c) Personal favorite tracking list

Figure 6.

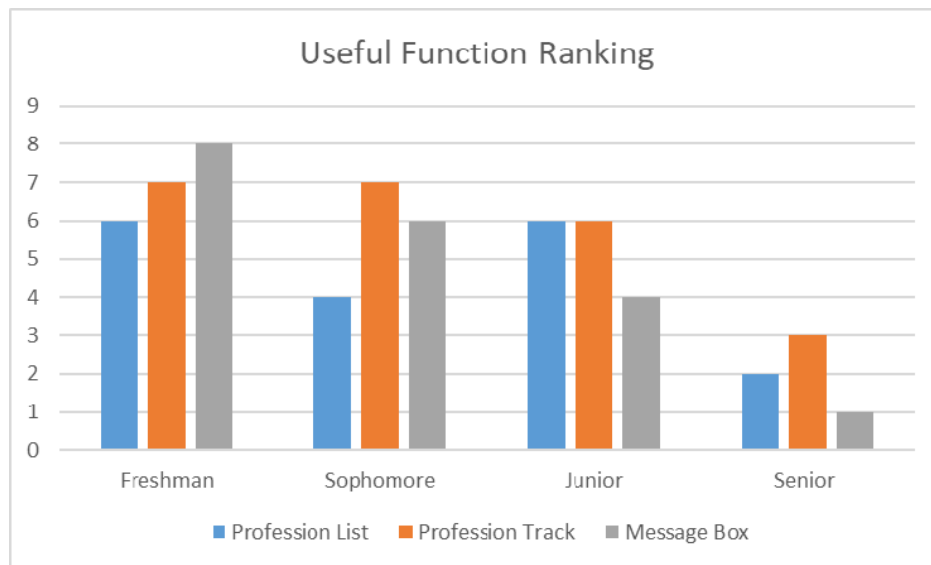
- Profession List: list the professional occupations belonging to his/her master domain.
- Profession Track: keep track of his/her favorite occupations.
- Message Box: notify/inform the necessary curricula relating his/her favorite occupations.

## 5 Conclusion

This proposed WPA application emphasizes easy access on most platforms, easy operation user interface (UI)/user experience (UX), and active notification. It enables the undergraduates to better understand their own learning direction and plan a learning schedule so that the users can more effectively use their resources to strengthen their abilities and achieve their goals. In addition, it can help the users choose what they can do or what they like to do. Finally, let the users know the distance from their target occupation through the score

evaluation.

We explain this proposed application to the undergraduates in freshman, sophomore, junior, and senior and inquire them about user experience. The study case consisted of 28 students. On the whole, the professional tracking function is the most useful for their learning direction. 82.1% of students think that it is helpful for them. Then we distinguish the students according to the grade and show the result in Figure 7. For freshmen, “Message Box” informs them about the taking courses advice and is the most helpful. Obviously, professional tracking is more interested in the rest of students.



**Figure 7.** Case study for useful function of the proposed WPA application

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## Biographies



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