PROCEEDINGS OF SCIENCE

Interest-based Occupation Recommendation

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A mass of adolescents has decided their occupations/jobs/majors out of proper and professional advice from school services. For instance, adolescents do not have adequate information about occupations/jobs, what occupations can be reached by which majors, and what kind of education and training are needed for particular jobs. On the other hand, major choices of adolescents are influenced by a society and their family. They receive occupational information in common jobs from the environment. But they are a lack of information in professional occupations. Furthermore, the choice of major has become increasingly complex due to the existence of multiple human skills, which mean each person has their ability at the certain area and can be applied to multiple jobs/occupations. For those reasons, students need an automatic counselling system according to their values. To do this, occupation recommendation system is implemented with a variety of IT and soft skills. The main goal of this research is to build an occupation recommendation system (ORS) by using data mining and natural language processing (NLP) methods on open educational resource (OER) and skill dataset, in order to help adolescents. The system can provide different variety of academic programs, required skills, ability, knowledge, and job tasks as well as relevant occupational descriptions. The system can assist adolescents in major selection and career planning. Furthermore, the system incorporates a set of searching results, which are recommended using similarity measurements and hybridization recommendation techniques. These methods serve as a base for recommending occupations that meet interests and competencies of adolescents.

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1. Introduction

Students make initial and critical decisions regarding what to study further and which career path to pursue [1]. Many students enter post-secondary education without a clear idea of their major and future career plans. Mismatch of the major choice and lack of processing information through the professional study is one of the reasons to switch the major. Such changes are wasteful in time and resources, and also it is the cause of emotional and financial stresses of students. An approximated twenty to fifty percent of students enter college as undecided; and an approximated seventy-five percent of students change their major at least once before graduation [2]. Due to the rapid development of society, students need counselling session as early as possible to enable them to choose a suitable major/occupation. The choice of major has become increasingly complex due to the existence of multiple human skills which mean each person has their ability at the certain area and can be applied to multiple majors/occupations.

There are many researches that only provide a job recommendation to users as job seekers that will be limited usage. Most of the students do not possess adequate information about meaning of occupations/majors, what careers can be reached by which majors, and what kind of skills and abilities are needed for a particular occupation/major. For those reasons, students need an automatic counselling system according to their values. To do this, we propose to implement competency-based occupation recommendation system to assist adolescents. Our proposed system designed for adolescents, elementary, high school and undergraduate students but not limited to another kind of users.

2. Methodology

2.1 Dataset

Occupation. Around 1000 occupations and their descriptions are employed to provide information of occupations. The system showed top 5 skills, 5 knowledge, 5 abilities, 2 or 3 interests, 5 tasks, and 5 related occupations for each occupation on the website [5]. Moreover, we extracted 1296 wiki occupations in 41 categories from Wikipedia as linked open data. The mapping of data is performed and basic text analytics and recommendation techniques is applied.

User. 443 adolescents were participated in this experiment since 2015 year. As they filled that 179 participants are male while 147 participants are female. Likewise, 195 adolescents out of total students filled the intended and suggested occupations and answered the vocational interest questionnaire.

Figure 1: Representations of vocational interest factors

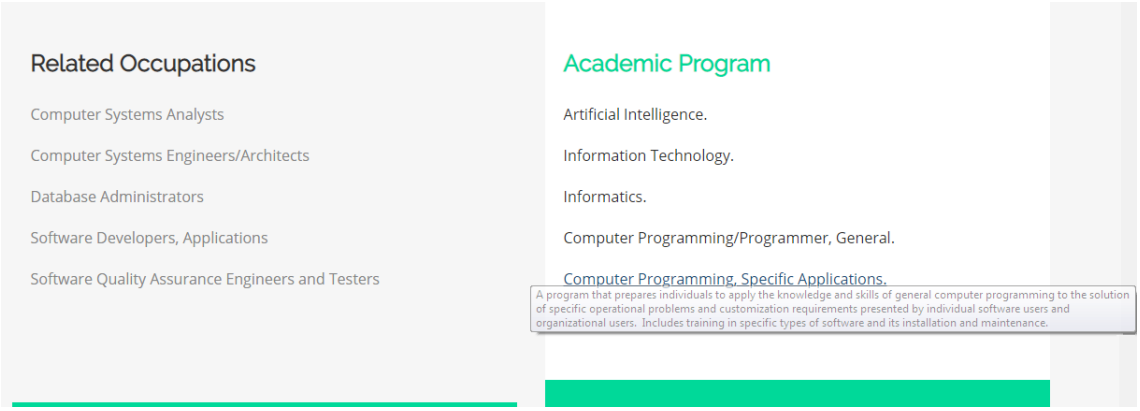


Figure 2: Sample of occupation's alternative occupations and Academic program for Software Developers, Systems Software.

Vocational Interests. Holland code (HC) model with the 106-item [3,4] was used as a measure of students' vocational interests. Students rate their level of interest in each occupational description on a Likert scale (strongly dislike to strongly like). There are 6 factors (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional - RIASEC). Scoring the highest 2 or 3 factors are necessary to discover an interested occupation or vocational interest, and a useful description, such as SIC (Social, Investigative, and Conventional), IRC (Investigative, Realistic, and Conventional), etc. Internal consistency reliability of vocational interests is .96. The factors could be seen in Figure 1. The system also shows academic program and alternate occupations. (See Figure 2.)

2.2 Methods

In this study, recommendation methods are employed to compare differences in interests and skills between the intended occupation and an occupation from the interest questionnaire since our users are adolescents without any job experiences. Item-based CF and term frequency–inverse document frequency methods were used for all necessary calculations. An item-based CF method [5] is applied to find out interest-based occupation for considering all interests. And, we calculate similarities for each occupation. Then one of the most similar occupation is selected as interest-based occupation of an active student.

Moreover, when the above student registers to the system, the system asks for the intended occupation. His intended occupation is Teacher. But in our occupational knowledge base, there are many kinds of teachers such as Agricultural Sciences Teachers, Postsecondary, Elementary School Teachers, Physics Teachers and so on. Hence, term frequency–inverse document frequency method [5, 6] is used to identify and match the intended occupation into occupational knowledge base. The matching suggests the student's intended based-occupation is Teacher Assistant (see Figure 3).

The system gives four lists as recommended occupations to adolescents. The four lists are the intended, suggested (by parent), skill-based and interest-based occupations. Then, the system asks adolescents which list they like the most as a feedback about the recommended occupations (See Figure 3). Finally, the system provides links on the recommended occupations of the liked list for specific detail that user can discover for more information about interested occupations.

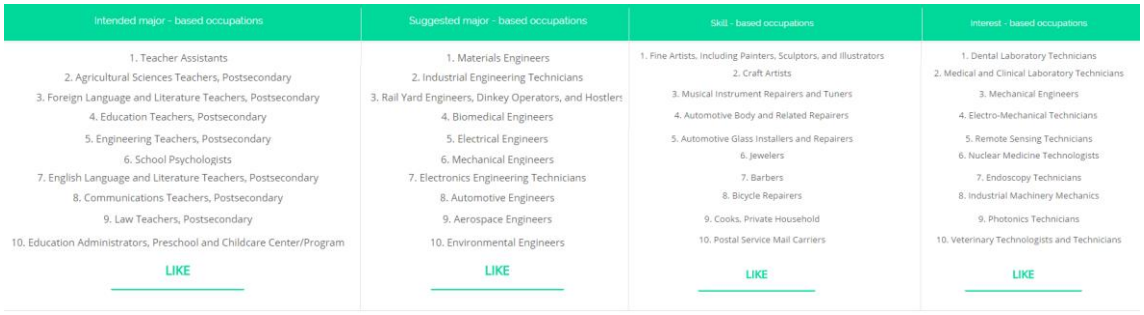
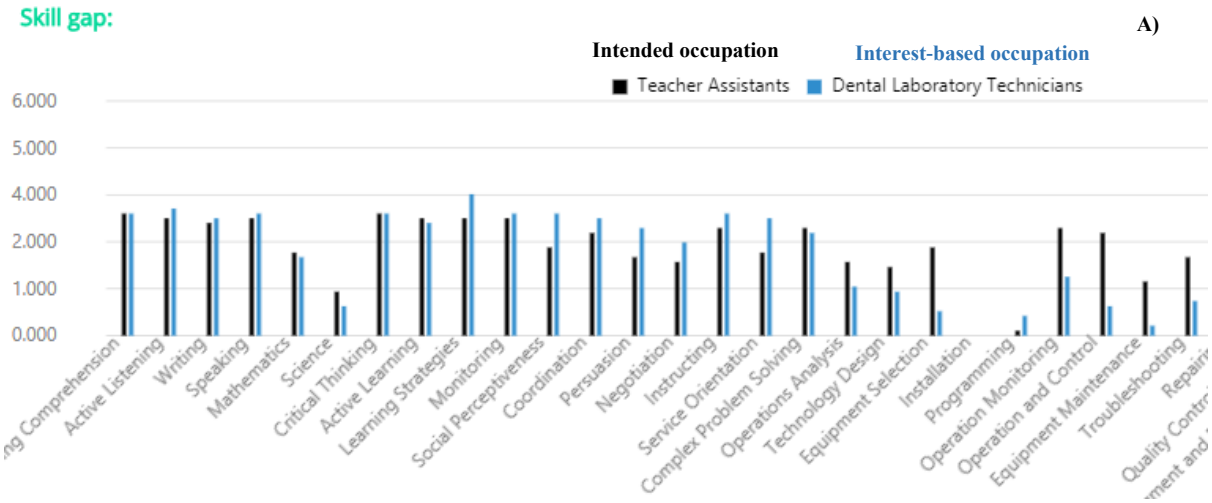


Figure 3: Feedback example of student ID 1364: his intended occupation as a Teacher, suggested occupation as an Engineer in the registration page. Skill-based and interest-based occupations are from questionnaires. He gave the like in the suggested occupation list.

In the top of Figure 4, A) illustrates each 35 skills on interest-based and intended-based occupations. A list is in the bottom of Figure 4 B) that shows top 5 skill gaps according to intended occupations. A list is in the bottom of Figure 4 C) that shows top 5 skill gaps according to interest-based occupations. In practical case, teachers can use this graph to guide/counsel adolescents what skills should improve.



Хамгийн их зөрүүтэй байгаа 5 чадварыг доорх жагсаалтаас харна уу:
1.Service Orientation - Difference: 0.88
Actively looking for ways to help people.

B)

2.Social Perceptiveness - Difference: 0.87
Being aware of others' reactions and understanding why they react as they do.
3.Persuasion - Difference: 0.75
Persuading others to change their minds or behavior.
4.Learning Strategies - Difference: 0.62
Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.
5.Negotiation - Difference: 0.5
Bringing others together and trying to reconcile differences.

Хамгийн их зөрүүтэй байгаа 5 чадварыг доорх жагсаалтаас харна уу:
1.Repairing - Difference: 1.88
Repairing machines or systems using the needed tools.

C)

2.Operation and Control - Difference: 1.87
Controlling operations of equipment or systems.
3.Quality Control Analysis - Difference: 1.87
Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
4.Equipment Selection - Difference: 1.63
Determining the kind of tools and equipment needed to do a job.
5.Management of Material Resources - Difference: 1.38
Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.

Figure 3. Example of student ID 1364's graph on interest-based and intended occupations in skills.

3.Result

In this section, we present our experimental results of skill and interest gaps on 195 students based on their interest-based and intended occupations. Mean Absolute Error (MAE) measures an average magnitude of the errors without considering their direction. In our case, it is applied the average magnitude of gaps in skills for all students. The results are shown in

Table 1. Lower values show better results in skill gap. It indicates that the majority of adolescents have skill gaps on Operation and Control, Science, Instructing, Science, and Operation Monitoring skills. On the other hand, students may know some skills of a certain occupation but they may not understand what other skills come with that profession. For instance, the occupation may require more math or technical skills than those students know.

Table 1

MAE of skills between interest-based and intended occupations for all students

Skill name	**MAE**	**Skill name**	**MAE**
1.Operation and Control	0.96	19.Speaking	0.49
2.Science	0.85	20.Social Perceptiveness	0.49
3.Instructing	0.75	21.Equipment Selection	0.49
4.Operation Monitoring	0.7	22.Complex Problem Solving	0.47
5.Quality Control Analysis	0.67	23.Negotiation	0.46
6.Learning Strategies	0.65	24.Judgment and Decision Making	0.45
7.Troubleshooting	0.64	25.Programming	0.44
8.Operations Analysis	0.63	26.Equipment Maintenance	0.44
9.Systems Evaluation	0.62	27.Persuasion	0.43
10.Service Orientation	0.62	28.Repairing	0.41
11.Systems Analysis	0.61	29.Critical Thinking	0.4
12.Mathematics	0.6	30.Technology Design	0.4
13.Writing	0.58	31.Active Listening	0.38
14.Management of Financial Resources	0.53	32.Coordination	0.36
15.Reading Comprehension	0.52	33.Time Management	0.34
16.Management of Personnel Resources	0.52	34.Monitoring	0.31
17.Management of Material Resources	0.51	35.Installation	0.08
18.Active Learning	0.5		

The results of 195 students in interest gap are shown in Table 2. A range of MAE is from 0 to 1. Lower values show better results in interest gap as well. The result points out that even students have their own intended occupation according to their interests, but that interests are different than interests detected by vocational detail questionnaire. It is better to guide/counsel adolescents on skills and interests with coordinating their personalities and learning styles, in view of the fact that personalities and learning styles are not easily changeable and also can be detected in early age. But, some skills are not easy to be identified and interests are changeable. Thus, personalities and learning styles can be used with skills and interests for discovering some undetectable skills. In addition, the system suggests suitable occupation for students, to discover their occupational interests and to guide them to improve their skills and to recognize themselves through their interest gaps.

Table 2

MAE of interests between interest-based and intended occupations for all students

Factors	Realistic	Investigative	Artistic	Social	Enterprising	Conventional
MAE	0.48	0.36	0.34	0.34	0.28	0.26

4.Conclusion

Consequently, we experimented the interest-based occupation recommendation system and conducted the experiments with the students in their skill and interest gaps. In order to recommend the well-fitting occupation to students using their vocational interest and skill, we employed the recommendation algorithms. The system not only recommends occupations but also makes guidance. The result indicated that vocational interest could be utilized for the guidance and the recommendation of the suitable occupations/majors of students. In the future, we will conduct an online course in the career counselling session using MOOC and Wiki Education Foundation, and to track students' interested learning directions. Another future study is to build an iterative dialogue system according to this proposed system's improvement.

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