DATA MINING THE CATEGORIES OF TEACHERS AND OFFERING PROMOTION STRATEGIES FOR THE MAINSTREAM - CASE OF A TECHNOLOGY UNIVERSITY IN TAIWAN

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ABSTRACT

Teachers constitute a vital part of an educational institution. A typical university world over consists of teachers mainly engaged in activities of teaching, research, and administration (service). However, not all teachers are efficient enough to perform all three activities in equal measures. It creates an imbalance and leads to differences in their performances and, in turn, affects their promotion. In the last decade, teachers in the case university, who outperformed in research got priority in promotion compared to others. It created disparities in promotion avenues among the teachers. Therefore, the question before the Management was how to overcome this imbalance and develop measures appropriate for all teachers. The present study attempts to diagnose the categories/clusters of teachers in a case university and devise suitable evaluation measures for their promotion. We linked data on teachers' evaluation of activities related to teaching, research, and administration. Records of 343 teachers were analyzed. Basic statistical analysis, ANOVA, correlation, and C5 decision tree were carried out. Teachers' teaching evaluation scores varied significantly by gender and had a positive relationship with research, service, and students' performance. Concerning the professional title, 70% of teachers (lecturers, assistants, or associate professors) belonged to the teaching group, and merely 3% of faculties in this group got promotions in the last eight years. Thus, the case university needed to devise appropriate measures to improve the odds of promotion of teachers in this group. The present study dwells on these aspects and discusses certain measures for adoption.

Keywords: Job resources; Teacher expertise; Teaching practice research program; Teacher evaluation; Teacher promotion

Introduction

Teachers constitute a vital part of an educational institution. In a typical university world over, teachers are mainly engaged in activities of teaching, research, and administration (service). In the higher education setting, like in universities, teachers not only have to teach courses but also carry out research, publish papers, tutor, and perform certain administrative duties. Moreover, teachers in doctoral universities, besides teaching courses, are required to submit research proposals to attract funding, carry out research, supervise students for research, and perform certain administrative duties. The quality and performance of teachers not only affect the university but also has a bearing on their career development, including promotion.

Though research output is a crucial component of teachers' performance appraisal, not all teachers can do well in this respect. In two separate previous studies, it was reported that 43% of faculty members did not report any publication two years before the survey date (Finkelstein 1984), while 41% of faculty members had never published anything (Boyer 1990). It creates disparities in promotion avenues among the teachers and poses a question before the Management that how to overcome this imbalance and develop measures appropriate for all teachers. Boyer (1990) conceptualized faculty work in four different kinds of 'scholarship' in which university teachers are generally engaged. (1) The scholarship of discovery (traditional research and creative activity), (2) the scholarship of integration (synthesis of theoretical or empirical material within or across disciplines), (3) the scholarship of application (use of ideas from one's occupation for solving problems), and (4) the scholarship of teaching (now generally referred to as the scholarship of teaching and learning). Boyer (1990) encourages faculty belonged to the category of teaching scholarship to go beyond the content of their specific disciplines, to research and apply pedagogical methods, and to share their findings with their colleagues. Thus, faculty members who cannot contribute to research output can develop unique expertise according to their characteristics and still make a unique contribution.

In addition, Blair (2018) proposed a similar idea of stating that academic roles could be separated into a lecture (teaching), conference (research), and lecturer (scholarship) to reduce the educational load. However, on the other hand, some researchers recommended the collaboration of the three duties (Galal et al., 2014; Kandiah and Saiki, 2012; Walsh and Wright, 2016). Whitfield and Hickerson (2013) designed a checklist for teachers to assess their preparedness for teaching, service, and research. It was found that most had participated in teaching preparation activities (Whitfield and Hickerson, 2013). In a research-oriented university, however, the strategy of encouraging teaching lecturers to develop service and research and then get promotion becomes a vital challenge.

Therefore, Ho (2015) described that if the system of teachers' promotion can be combined with the orientation of the school, distinguishing feature development, incentives, and the expertise of teachers, then the motivation and willingness of teachers to cooperate with institutional promotion, teaching and research tasks, and industry-university cooperation will be relatively

improved. In 2015, the Ministry of Education (MOE) in Taiwan assigned three universities to demonstrate three different promotion pathways for teachers. It was concluded that besides research incentives, teaching practice and industry-university cooperation are the other two areas worth considering. Subsequently, the MOE in 2018 advocated the program of teaching practice and research to implement teaching innovation and strengthen the task of cultivating talents in universities.

The teacher evaluation consists of a combination of teaching, services, and research. Several studies have identified the factors influencing teachers' evaluation, including background variables such as field, gender, and professional title, etc. (Drake et al., 2019; Hameed et al., 2015; Li et al., 2016; Wang et al., 2017), students' grade point average (Akram and Zepeda, 2013; Sayavedra, 2014), tutor and student relationship (Agrawal et al., 2019; Horneffer et al., 2016), administrative position (Argyriou et al., 2014; Williams and Crates, 2015) and research performance (Cai, 2015; Wang et al., 2016). In the present research, these factors were considered to detect their influences on teaching, service, and research performance.

The research structure is shown in **Figure 1**. The study aims (1) to explore the factors influencing teachers' evaluation/promotion considering activities of teaching, research, and administration (service), (2) to examine the correlation among scores of teaching evaluation, tutor-student relationship, administrative duties, and research output. (3) to clarify the category of most teachers in the case university and offer helpful suggestions for decision-makers. The C5 data mining in the study was carried out to diagnose teachers' cluster types based on their expertise in the case university. The study's outcome may be useful to improve the odds of promotion of faculties belonging to the teaching cluster and help the Management of other universities tackle similar situations in their institutions.

Figure1: Research structure

LITERATURE REVIEW

TEACHING QUALITY ASSESSMENT
There are several research reports available on teaching evaluation to assure teaching quality. According to Marsh and Roche (1997), a valid teaching evaluation offers: (1) useful feedback for diagnosing strengths and weaknesses in teaching effectiveness, (2) provides the suggestions for professional development aimed at improving teaching, and (3) creates a tangible incentive in working towards improving teaching. Cohen (1980) described that student-rating feedback had made a modest but significant contribution to the teaching improvement. Bianchini, Lissoni, and Pezzoni (2013) analyzed the determinants of teaching quality and proposed a new statistical methodology to measure instructors' characteristics. Bianchini (2014) listed several items related to teaching dimensions, such as punctuality, willingness to clarify, ability to raise interest, clarity in exposition, and quality of educational material. Ho (2015) described that teaching quality assessment could roughly include teachers' teaching ability, curriculum organization, teacher-student interaction, course difficulty, course burden, lecture assignments, assessment methods, teaching enthusiasm, and student learning effectiveness/value. These contents not only remind teachers of the importance of teaching behavior but also reflect students' need for their teaching.

C5 data mining
Data mining is the computational procedure of discovering patterns in big data sets, which include the methods at the intersection of statistics, decision trees, artificial intelligence, machine learning, and database systems (Michael and Gordon, 1997; Zare et al., 2019). Take the decision tree for an example; the goal of classification is to predict the value of a user-specified goal attribute based on the values of other attributes, known as the predicting attributes. C5 is an algorithm used to generate a decision tree developed by Ross Quinlan (2017). C5 can create classifiers demonstrated either as decision trees or as rule sets. It handles missing data, can deal with a large number of input variables, and builds models efficiently. The decision tree is built in a top-down graph. The first attribute is at the top of the tree, and the next branch leads to either a new attribute or output. C5 decision trees are created from several features, and then the tree is classified by using a subsequent set to build the model. Besides, the algorithm of C5 can extract valuable patterns and create improved features (Khanbabaei et al., 2019; Khraisat et al., 2020; Pandya and Pandya, 2015; Razi and Shahabi, 2016). In the present study, the C5 decision tree was applied to explore the types of scholarships among the teachers in the case university.

TEACHER PROMOTION
The teachers' promotion is related to the outcome of activities in their respective professional fields. According to the MOE (2016), Taiwan, there are guidelines for different categories of teachers' field of activities for promotion purposes:

> (1) Academic research: Teachers who have made specific contributions to the research results in an academic field have been able to submit outstanding works for review.

(2) Industry-university cooperation: Teachers in applied science and technology, who have innovated, improved, or extended the specific research and development results of the specific technology or practice can submit the technical report for review.

(3) Teaching practice: Teachers' role in the development of curriculum, teaching materials, teaching methods, teaching aids, the use of scientific and technological media, assessment tools, innovative, improvised, or extended application of specific research and development results, and who can effectively improve students' learning outcome or promote significant contributions within and outside the school. Teachers can submit all these contributions in the form of a technical report for review.

(4) Art or sport: In the academic field, art teachers have unique and specific contributions. They can submit their creation or performance reports for review. The sports teachers themselves or student-athletes under their guidance can participate in significant domestic and international sports competitions to win ranking, and teachers can obtain a certificate of achievement and submit it for review.

TEACHING PRACTICE RESEARCH PROGRAM

Taiwan's MOE (2018) defined the program on teacher's efforts to improve the quality of teaching, promote the learning outcomes of university students; raise questions through educational materials or literature, through curriculum design, teaching materials; or by the introduction of teaching aids and the use of technology media. The teachers who received the subsidy from the MOE are required to share and present their research outcomes to the public. The integrated teacher assessment system will be a diversified approach providing teachers with the ability to grow and develop innovative pedagogies, and create an institutional research database for students' learning improvement. In the case of universities, the number of teachers who pass the teaching practice research program increased (MOE, 2018). Therefore, more teaching resources could be the new driving force for the teacher's promotion.

JOB RESOURCES

Job resources are physical, psychological, social, or institutional aspects of the job that may reduce job demands and the associated inner and outer costs. Xanthopoulou et al. (2007) stated that job resources are related to personal characteristics such as employees' self-esteem, self-efficacy, and optimism and influence their work environment. A lack of job resources leads to teachers' stress and diminishing job satisfaction (Demerouti et al., 2001). Chism (2006) and Song et al. (2013) mentioned that institutions should have a system to acknowledge and recognize the excellence in teachers who could inspire other faculty members to achieve higher levels of performance in teaching. Through career promotion, a teacher can have more job resources like a higher salary, a fewer curriculum, more assistants, and a higher reputation. Also, these measures will lead to enhanced chances of their retention in the university

METHODS

SAMPLES AND PROCEDURE

In the present study, we linked data of teaching evaluation scores, tutor-student relationship scores, projects, and publication statistics (Scopus indexed journals only), and the administrative duties in the case university. The secondary data was collected from the offices of academic affairs, students' affairs, research and development, and human resources. All the data had identification numbers, hence no ethical issues. A total of 343 valid teaching evaluation records of teachers in the case university in the academic year 2017-18 were analyzed. To understand the composition structure of teachers in the case university, first, the basic statistics were carried out. Secondly, through ANOVA, the significant factors which influenced the teachers' evaluation were detected. Thirdly, the correlation coefficient of teaching, research, and service were analyzed. Finally, according to C5 cluster rules, three categories of teachers were explored.

MEASURES AND VARIABLES

The main variables related to a teacher are professional field, gender, professional title, administrative position, evaluation performance, projects, publication output, and students' grade point average (GPA) in curriculums taught by the teacher.

To explore the correlation among teaching, service, and research, we linked the secondary data from different offices. Using a questionnaire, the office of academic affairs collected the data on teacher evaluation scores to diagnose the teaching performance. The questions included were:

(1) The content of the teacher's lecture is roughly consistent with the syllabus.
(2) The teacher's attitude is conscientious and well prepared.
(3) The teacher will assign assignments or arrange exams to assess student learning outcomes.
(4) The teacher will attend classes on time and will not be absent for no reason except for special purposes.
(5) The teacher will encourage the students to ask questions and be happy to answer questions for the students.
(6) I am satisfied with the teacher's overall teaching.

The Office of Students' Affairs collected the tutor's scores. The "Class Tutor and Student Relationship Questionnaire" contained the following eight items:

(1) I think the tutor cares about me.
(2) I think the tutor is willing to help students in solving problems.
(3) I think the tutor will take the initiative to understand my situation.
(4) I think the tutor has a good communication channel with students.
(5) When I need it, I know how to contact the instructor.
(6) When I have difficulty, I am willing to discuss with the tutor or request assistance.

Students answered using a five-point scale; the options were "strongly agree," "agree," "neutral," "disagree," and "strongly disagree." The scoring order was 5,4,3,2 and 1 point, respectively. The higher the score, the more satisfied the student was with the tutor.

To predict the teachers' expertise, we applied C5 data mining in the study. It includes six fields (General Education Center:1, Management:2, Science and Engineering:3, Design:4, Humanities, and Social Sciences:5, Informatics:6). Gender was coded as male: 1 and female: 0. The professional titles were coded as a distinguished professor:5, professor:4, associate professor:3, assistant professor:2, and lecturer:1. Tutors were coded as Yes:1 and No:0. Administrative duties were coded as Yes:1 and No:0. Research output was coded as Yes:1 and No:0. Moreover, the dependent variable is the scholarship type (Teaching, research, service).

Also, following the regulations for the promotion of university teachers in Taiwan, we collected promotion data of eight years (August 2010 to July 2018) in the case university to carry out a basic statistical analysis. Thus, from the results, we could check the allocation of the resources concerning teaching, research, and service and could see the weight of factors.

Results

BASIC STATISTICS

Table 1: Frequency counts of all teachers

Item		Count
Field	Management	106
	Science & Engineering	55
	Design	48
	Humanities & Social Sciences	54
	Informatics	52
	General Education	28
Gender	Male	230
	Female	113
Professional title	Lecturer	27
	Assistant professor	125
	Associate professor	140
	Professor	47
	Distinguished Professor	4
Tutor	No	161
	Yes	182
Administration	No	296
	Yes	47
Research	No	268
	Yes	75

The frequency statistics of 343 teachers are shown in Table 1. The number of teachers in the field of Management was higher compared to other areas. Overall, the number of male teachers was higher than females. Associate and assistant professors outnumbered other professional titles. Data showed that over half the number of teachers took up tutoring. Only 47 (14%) of all faculties had additional administrative duties, while 75 (22% of the total number) had research output in the form of publications.

EVALUATION OF TEACHING

TABLE 2: ANOVA

		SS	df	MS	F	Sig
Gender * Teaching	Between	0.241	1	0.241	5.572	0.019
	Within	14.748	341	0.043		
	Total	14.989	342			
Field*Research	Between	11.303	5	2.261	16.106	0.000
	Within	47.298	337	0.140		
	Total	58.601	342			
Professional Title*Research	Between	8.596	4	2.149	14.527	0.000
	Within	50.004	338	0.148		
	Total	58.601	342			
Field*Tutor	Between	102.010	5	20.402	4.538	0.001
	Within	1514.950	337	4.495		
	Total	1616.960	342			
Gender*Tutor	Between	18.743	1	18.743	3.999	0.046
	Within	1598.217	341	4.687		
	Total	1616.960	342			
Field*Administration*Research	Between	2.811	4	0.703	4.477	0.004
	Within	6.593	42	0.157		
	Total	9.404	46			
Professional Title*Administration *Research	Between	1.404	2	0.702	3.862	0.028
	Within	8.000	44	0.182		
	Total	9.404	46			

The teaching evaluation scores varied significantly by gender, and ANOVA (Table 2) showed that female teachers had higher teaching evaluation scores than males (p-value=.019). Besides, we collected the data and linked 343 teachers' teaching evaluation scores and their different curriculum grade point average (GPA) in the report of the database. Correlation analysis results showed that the higher the rating of the teaching evaluation scores, the better was the GPA of students in the curriculum. It was positively significant. Teaching evaluation scores of a teacher declined if the number of failed students was higher.

EVALUATION OF RESEARCH

The Chi-square test showed that the factors of the professional title and field had a significant difference (p-value=.000) in research output (Table 3). Distinguished professors and professors had significantly higher research output than others. It was found that the higher the professional title higher was the research output. Teachers in the field of Informatics and Science and Engineering had more projects and a higher number of publications compared to teachers in other areas. Art teachers, though produced creations but had less research output. Sports teachers contributed differently to specialized events and trained students to participate in various sports competitions hence had no research output. Teachers in the field of Humanities and Social Sciences and General Education had a higher focus on the teaching practice; therefore, it had less research output as well.

Table 3: Crosstable

			Research		Total
			No	Yes	
Professional title	Lecturer	Count	27	0	27
		%Within Professional title	100.00%	0.00%	100.00%
	Assistant professor	Count	108	17	125
		%Within Professional title	86.40%	13.60%	100.00%
	Associate professor	Count	110	30	140
		%Within Professional title	78.60%	21.40%	100.00%
	Professor	Count	23	24	47
		%Within Professional title	48.90%	51.10%	100.00%
	Distinguished professor	Count	0	4	4
		%Within Professional title	0.00%	100.00%	100.00%
Total		Count	268	75	343
		%Within Professional title	78.10%	21.90%	100.00%
Field	General Education	Count	28	0	28
		%Within Field	100.00%	0.00%	100.00%
	Management	Count	88	18	106
		%Within Field	83.00%	17.00%	100.00%
	Science& Engineering	Count	33	22	55
		%Within Field	60.00%	**40.00%**	100.00%
	Design	Count	42	6	48
		%Within Field	87.50%	12.50%	100.00%
	Humanities & Social Sciences	Count	53	1	54
		%Within Field	98.10%	1.90%	100.00%
	Informatics	Count	24	28	52
		%Within Field	46.20%	**53.80%**	100.00%
Total		Count	268	75	343
		%Within Field	78.10%	21.90%	100.00%

EVALUATION OF SERVICE

ADMINISTRATIVE DUTIES
Totally 47 teachers had administrative duties. The statistical analysis shows that the research performance of teachers with administrative responsibilities had a significant difference by the variables of fields and professional titles (Table 2).

TUTOR-STUDENT RELATIONSHIP
By ANOVA (Table 2), the scores of the tutor-student relationship were significantly different from professional fields, and gender (the p-value was significantly smaller than 0.05). The rating of the tutor-student relationship was higher in the field of Informatics but was lower in the area of Arts. Regarding gender, female tutors (Average=4.43) had higher popularity than male teachers (Average=4.26) shown in Table 4.

Table 4: Basic statistics of tutor and student relationship scores

Item		Count	Mean	SD
Field[**(.000)]	general knowledge	28	**4.40**	0.29
	management	106	4.35	0.30
	science	55	4.37	0.33
	design	48	4.16	0.51
	humans	54	4.25	0.28
	information	52	**4.40**	0.32
Gender[** (.002)]	male	230	4.26	0.38
	female	113	**4.43**	0.27

*Note: ** p-value is significantly smaller than 0.01*

ODDS OF TEACHERS' PROMOTION
To know the promotion numbers in the case university, the original professor and distinguished professor were deleted in the participants; therefore, the samples were 322 to be analyzed. The odds rate of promotion in the case university for 8 years was only .35 (115/322) of total samples in the case university. The distribution was .27 in academic research (87), .05 in skill (17), and .03 in teaching practice (11).

CORRELATION
We tried to explore the correlation between the teaching, research output (projects and publications), service (administration and tutoring) (Table 5). The findings were as follows: (1) The teaching evaluation scores were positively related to research, administration, and tutor-student relationship scores. (2) The variable of service (administration and tutoring) was negatively related to research output. (3). The publications were significantly positive to projects (the p-value was significantly smaller than 0.05).

Table 5: Pearson Correlations of Work Types

Work types	1	2	3	4	5
1. Teaching	1				
2. Projects	.04	1			
3. Publications	.01	$.45^{**}$	1		
4. Administration	.09	.08	-.01	1	
5. Tutoring	.05	-.06	-.09	$-.24^{**}$	1

Note: ** p-value is significantly smaller than 0.01

TEACHERS CLUSTERS

Following the concept of 'Scholarship' by Boyer (1990), the C5 decision tree was applied to explore the type of scholarships among the teachers and to predict important factors, and create classified models. The independent variables were field, gender, and professional title. The dependent variable was the 'scholarship type,' e.g., teaching, research, and service (tutor and administration). The precision rate was .72. The models were as follows (Figure 2):

(1) For professional titles "Associate professor," "Assistant professor," or "Lecturer," the scholarship type was teaching.
(2) For the professional title "Professor," and the field of "Humanities and Social Sciences," the scholarship type was service.
(3) For the professional title "Professor," and the field of "Science & Engineering" or "Informatics," the scholarship type was research.
(4) For the professional title "Professor" and the field of "Management," "Design," or "General Education," the scholarship type was teaching.
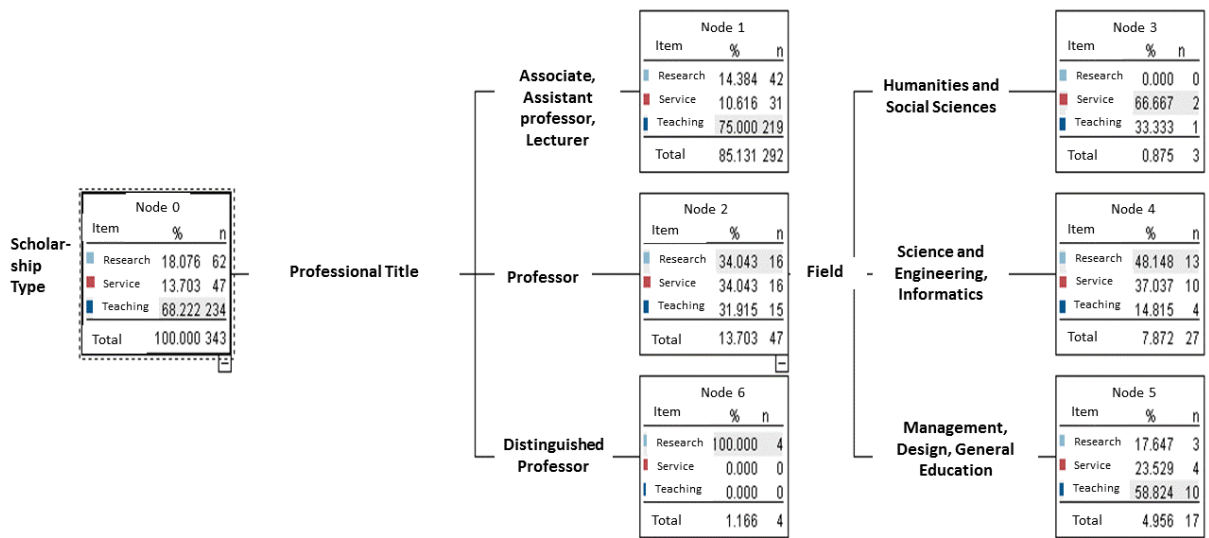(5) For the professional title "Distinguished Professor," the scholarship type was research.

Figure 2: C5 decision tree

From the composition structure, teaching was the main activity of the majority of faculties in the case of university (69%). Also, concerning the professional title as a variable (lecture, assistant professor, and associate professor), 75% belonged to the teaching cluster.

DISCUSSION

Basic Statistics Analysis
In basic statistics, the odds rate of promotion in the case university was .27 in academic research, .05 in skill, and .03 in teaching practice. Research output has a significant weight in the ranking of universities. Therefore, in recent years, higher attention is being paid to the research performance of teachers. As observed in the present study, several factors affected teachers' research output, e.g., workload (number of courses and administrative duties), their field of expertise, lack of research funding (especially in the case of lecturers and assistant professors). Several other reports have indicated that teacher's length of the probationary period, job tenure, teaching load, administrative duties, academic rank, and financial research support has a significant influence on research output (Buchheit et al., 2001; Cargile and Bublitz, 1986; Chen and Zhao, 2013; Chow and Harrison, 1998). Kim (2018) examined teachers' collaborative inquiry (knowledge, practice, communities, and purpose) as a professional development intervention to develop and implement a multicultural education program. The participants shared their experiences, discussed issues, and explored effective ways to achieve their goals based on formal or informal connections. Therefore, team cooperation among the local

institutions or international collaborations is the new trend for enhanced publication output.

Correlation Analysis

In the analysis of correlation, teaching was positive to research, service, and student performance. Therefore, the discussion on teaching strategy was necessary. In this study, it was found that teachers' gender influenced their teaching and tutor-student relationship scores. These results confirm the findings of previous researchers' (Agrawal et al., 2019; Lam et al., 2010; Van Houtte, 2007). Similarly, many researchers have stated that teachers' teaching performance has a significant positive impact on teacher-student interaction (Chen et al., 2006; Emmer et al., 1980), and teachers' professional identity influences their teaching strategies with different pedagogical beliefs (Berger and Van, 2019). Teacher's teaching evaluation scores declined if a higher number of students failed in that course. Previous studies have demonstrated that instructors with a higher degree of tolerance were more popular with students (Cheng et al., 2018; Kirk, 2017). Therefore, faculties in the teaching cluster, must mend their pedagogy and develop a helping attitude towards students to improve their performance/evaluation points.

Besides, it showed a negative relationship between tutorship and administrative duty in correlation analysis. While tutoring involves interactions with students, the administrative function is related to other affairs in the university. According to job resources theory, optimism depends on different characteristics among the teachers. Grayson and Alvarez (2008) reported that teachers who maintained a positive relationship with their students are more likely to stay motivated and enthusiastic and enjoy their work. Veldman et al., (2016) described that low teacher-student relationships showed relatively lower job satisfaction. Besides, some teachers get stressed by higher workload, interactions with colleagues, students, or parents (Greenglass and Burke, 2003). According to the theory of vocational personalities (Holland, 1997), teachers belonging to lower teaching and teacher-student relationship scores may be given a lower workload of social interactions.

Also, regarding job resources, some researchers had discussed the benefits of appointing teaching assistants (TA) as academic support for teachers (Cupido and Norodien-Fataar, 2018; D'Andrea and Gosling, 2005; Duthie and Freeman, 2016). The support of a sufficient budget and TA would be of great help in improving the learning process of students. Also, with the preparation of teaching materials, edit of e-learning videos, assistance in classrooms, a record of student's assignments, and the counseling of students for remedial education, the TA can decrease the workload of teaching faculties so that they can devote more time to innovate pedagogy, improve learners' performance, solve practical problems in the teaching area, etc. This way, the opportunities for promotion to faculties in the teaching cluster can be enhanced.

Data mining

From the composition structure and C5 teachers' clusters, it is clear that the mainstream teachers belonged to the teaching cluster in the case university. A load of teaching, research, and service can be assigned based on each teacher's cluster. For example, faculties who are efficient in

teaching can devote more time to designing new teaching methods and share them with their colleagues and other teaching community. Also, teachers should be encouraged to join the teaching practice research program run by the MOE to publish innovative topics in teaching (Huang, 2020; Lu, 2020). In the last ten years, only Taiwan's Ministry of Science and Technology (MOST), supported the budget for programs for the teachers in universities in Taiwan. However, in the recent five years, the MOE, Taiwan, also allocates a budget for teaching improvement, solving teaching problems, and encourages multiple approaches for teachers' promotion.

IMPLICATIONS AND RECOMMENDATIONS

The study presents the cluster model of teachers in a case technology university in Taiwan. Also, it points out ways for promotion and career development of university teachers based on their clusters. The faculties in the teaching cluster can apply for financial support from the government to research in their respective fields in addition to their teaching activities. Taiwan's MOST also supports the budget for skilled teachers to collaborate with industries to develop joint projects so that the research outcome has direct application to societal needs.

In addition to teaching strategies, teachers falling in the cluster of service could join the research cluster by presenting the paper or submission of projects in their disciplines. While those who belonged to the research cluster can carry out experiments, supervise students, publish their work, and write or edit technical books.

Teachers in the service cluster, who are efficient in the administration can devote more time to the framing of rules and regulations in the university, and in taking timely administrative decisions. These measures will lead to a higher satisfaction level among the different clusters of teachers, and their performance can be evaluated based on the flexible assessment system. Also, the university can judicially allocate resources based on the teacher's cluster and thus can significantly save on wasteful allocations. In this study, data related to only three clusters (teaching, research, and service) in the university were analyzed. Further study on industry-university cooperation and specialized disciplines like art and sports for promotions could be a subject of future research.

Conclusions

To strengthen its teacher development system, the Taiwan government has put in place a range of reforms over the last few years. Universities in Taiwan are required to have an evaluation system based on teachers' field of expertise, strength in deliverables so that appropriate career development and avenues of their promotion can be conceived. In this study, we analyzed the case of a Technology University in Taiwan. The results showed that the majority of the teachers in the university belonged to the teaching cluster. The study discussed measures and allocation of resources based on teachers' characteristics to improve the odds of promotion for the faculties belonging to the teaching cluster. Teachers with leadership potential can be encouraged to take up administrative roles within the university. At the same time, teachers with research aptitude and inventive minds who performed well in research output should be given resources to carry out advanced research and encouraged to apply for research funding from government agencies and private industries. Teachers with excellence in teaching and belonging to the teaching cluster should be encouraged to engage in improvisation of curriculum, teaching materials, innovative pedagogies, teaching methods, better teacher-student relationships, and enhancement in students' learning outcomes. Also, teachers in this cluster should be encouraged to apply for government funding for teaching-related research and share their findings with the teaching community. With these measures, not only university management can achieve the maximum output among different categories of teachers, but also create an ecosystem of teachers and students with a high degree of performance and a sense of fulfillment among all the stakeholders.

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