

Creative-oriented personality, creativity improvement, and innovation level enhancement

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Abstract This study is to provide a clear and validity way for the higher education system to enhance the innovation level and performance by confirming the creative-oriented personality as a point of reference for potentially considering creativity in admitting future college students and helping improve existing students' creativity. The value is that it is the first research to confirm the creative-oriented personality, thereby providing insight that is highly necessary if today's universities is to survive. The contribution is its comprehensive and directive type discussion of how innovation level of the university can be enhanced through both the admission of creative-oriented students and the improvement of existing students' creativity.

Keywords Personality · Creativity · Innovation · Fuzzy analytic hierarchy process (FAHP) · VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR)

1 Introduction

As the world becomes complex and change occurs at high speeds, with competition in every industry around the globe, the operations environment becomes more and more turbulent and uncertain (McCloskey 1995). There is no way to survive unless one innovates (Daft 2004; Krause 2004); this is no longer just a cliché but is instead really true; emphasized recently both in academia and by professionals, innovation is something that needs to be put into practice (Mumford 2000; Weifens et al. 2000; DiPietro and Anoruo 2006). Although there

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are various ways to innovate, among them, developing and applying knowledge is regarded as key to long-lasting innovative ability, as well as performance improvement and innovative production storage (Gardiner 1993).

Because the higher education system is the core of new knowledge creation, with its ability to foster high-tech talent, with the key factor of increasing national quality, and as the main way to upgrade national competitive ability (Fairweather 2000; Meek 2000; Chen and Chen 2010a,b,c), most countries are striving to improve operational performance in this area. This is especially true in Taiwan, with over half of the overall GDP coming from the high-tech industry (Chen and Chen 2009a,b) and the national goal that of becoming a kingdom of innovation (CNA 2009a,b).

However, facing today's global dynamic competitive environment, a drop in the birth rate, economic depression, WTO accession, and increased interaction with China (Taiwan Assessment and Evaluation Association 2006), the higher education system is losing its competitive advantage, and such consequences directly influence overall national quality and competitive ability worldwide. As a result, promoting innovation is intensely advocated in the higher education system.

Because creativity is the basis of innovation (Dewett and Gruys 2007), it is rationally believed that making a greater effort with regard to creativity could create indomitable innovation ability and performance for an organization. An organization that can nourish and effectively use human creativity has been confirmed to have a greater chance of succeeding (Williamson 2001) because of creativity as the source of novel ideas, organizational innovation, change, and competitiveness (Gilad 1984; Whiting 1988; Mumford 2000; Williamson 2001; Zhou and George 2003; DiPietro and Anoruo 2006). To continually build member capacity to generate, discover applications, and effectively store new knowledge is believed to greatly enhance creativity (Gardiner 1993; Chen and Chen 2010a,b,c).

Nevertheless, not all students are already highly creative or willing to improve their creativity. The biggest cause of this is found to be personality differences (Feist 1998; Chen and Chen 2008). Because of the significant relationship between personality and performance (Barrick et al. 2003; Hough 2003; Judge and Kristof-Brown 2003), this study suggests that admitting students who have creative-oriented personality will be more effective in increasing a university's innovation level and performance than will working to improve all students' creativity; the effects of the former strategy are believed to be greater and more long-lasting. Nonetheless, such research is still rare, especially on the topic of creative-oriented personality (Gilbert et al. 1996; Driver 2001; Allison 2004; Hervani and Helms 2004; Wynder 2004; Chen and Chen 2009a,b).

To overcome the above claim and to fully support enhancing the innovation level and performance of higher education system, this study aims to confirm the creative-oriented personality as a reference for future admitting possible creative student consideration, to help improve existed student's creativity, and further to help enhance the innovation level and performance of the higher education system. Note that measuring the importance of different creativity criteria before considering these questions is truly advisable (Wolfradt and Pretz 2001; Kaufman et al. 2007) because of individual difference correlates of creativity (Batey 2007). Additionally, because different creativity criteria and personalities ought to be taken into consideration in developing the research structure, multiple criteria decision making (MCDM) can be useful.

This study utilized a two-stage MCDM approach based on the fuzzy analytic hierarchy process (FAHP) and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR). The FAHP method is widely used for multiple criteria decision making (Zadeh 1965; Mikhailov 2003), and the practical applications reported in the literature have demonstrated the

advantage it offers in handling unquantifiable/qualitative criteria as well as the reliable results thus obtained (Hsieh et al. 2004). Moreover, the VIKOR method was developed as a multiple criteria decision-making method for solving discrete decision problems with noncommensurable and conflicting criteria (Opricovic and Tzeng 2004, 2007). It also emphasizes ranking and selecting from a set of alternatives, and it determines compromise solutions for problems with conflicting criteria, helping the decision-makers to reach a final decision (Opricovic and Tzeng 2007). Hence, the FAHP is first adopted to weight the creativity criteria; VIKOR is then used to confirm the most creative personality in accordance with the result of the FAHP.

The remainder of this study is organized as follows. A literature review is presented in Sect. 2. A two-stage MCDM approach is introduced in Sect. 3. An empirical study is conducted in Sect. 4. Discussions and implications are presented in the Sects. 5, and the conclusion is presented in the last section.

2 Literature review

2.1 Creativity

Creativity is a term with no certain, authoritative definition, standardized measurement technique or agreed upon set of valid measures (Furnham et al. 2008). In the field of psychology, approximately sixty definitions for the concept can be found (Taylor 1988). Among them, the traditional definition is regarded as the production of novel and useful ideas or solutions (Amabile 1988; Oldham and Cummings 1996; Shalley 1991; Zhou and George 2001), as proposed by Ghiselin in 1963 (Mumford and Gustafson 1988).

Currently, creativity is defined in many ways: as a cognitive and behavioral process consisting of multiple stages (Mohr 1982); a process of defining problems, making guesses, formulating hypotheses, communicating ideas to others and contradicting authority (Torrence 1988); a quality wholly bound up with the structure of the social institutions in which people work and live (Mozart 1993); a complex enough phenomenon that the structures and processes underlying novel idea generation will not be enough to explain it fully (Sternberg 1999); as actions, processes, and programs that are meaningfully novel relative to existing practices (Bharadwaj and Menon 2000); as a process requiring social support and one that must rest on a solid foundation of skills and training (Williamson 2001); the interrelationship between individuals and their situation, which determines whether they exhibit creativity (George and Zhou 2001; Oldham and Cummings 1996; Woodman et al. 1993; Zhou 2003); a balance between novelty and familiarity: new and different enough to capture consumers' attention, but familiar enough to not be misunderstood or rejected out of hand as too radically different (Ward 2004); the constant recycling and recombination of a finite stock of ideas (Magee 2005); a manifestation of productive energy and what might be called a productivity-minded attitude on the part of a people (DiPietro and Anoruo 2006); and the production end of ideas or products (Persaud 2007). Because the concept of creativity is ever-evolving (Weiner 2000) due to its dynamic nature (Sternberg 1988, 1999), after summarizing the related researches findings, it is perhaps best to put it simply: it is a complex human perception-action process that turns out not just as a novel but also as a useful idea into a practical action that others have not yet conceived of or have not effectuated.

As described in the previous section, there are numerous methods of evaluating creativity. Nevertheless, using multiple criteria is the most highly recommended method not just because it provides comprehensive agreement on individual difference correlates of creativity (Wolfradt and Pretz 2001; Batey 2007) but also because a lack of related research has

been performed to date. To fulfill the purpose of this study, multiple creativity criteria are taken into account. That is, this study uses a creativity measurement structure, emphasizing college students as proposed by Wu et al. in 2009 after a series of conscientious investigations and extraction from a literature review and the categorization of expert opinions (Wu et al. 2009). A detailed discussion on this subject will be presented later.

2.2 Personalities

As observed, not all students are creative or can improve their level of creativity. Such a phenomenon can also be found in other industries. The main reason for this is believed to be the existence of different personalities (Chen and Chen 2008). Because personality differences are found to have great effects on the operational performance of an organization (Barrick et al. 2003; Hough 2003; Judge and Kristof-Brown 2003), it can be rationally assumed that a creative personality encourages the improvement and enhancement of an organization's innovation level and performance. Moreover, for the higher education system, admitting creativity-oriented students is better than just improving all students' creativity in terms of increasing university-wide innovation level and performance efficiently and in both the short and long term, as noted in the above section.

Similar to the measurement of creativity, the methods and categories used for the measurement of personality are also varied (Funder 2001; Hurtz and Donovan 2000; Barrick et al. 2001). However, although these methods and categories are indeed numerous, most studies have suggested that all personality measures can be reduced to or categorized under the umbrella of a 5-factor model of personality (Costa and McCrea 1986), which has been labeled the "Big Five" (Timothy et al. 1999) and contains five personal traits: extraversion, conscientiousness, agreeableness, neuroticism, and openness to experience (Judge et al. 2002). We can have additional confidence in the Big Five in research not just because of the great number of studies advocating it (Salgado 1997; Roberts and DelVecchio 2000) but also because of the constancy of these results (Friedman et al. 1995). Thus, the study adopts the Big Five concept as a guiding element of the research structure.

2.3 An inference for creativity and personality

Although scientific facts increased during the past over 45 years proved that one who cannot generate creative idea as well as make creative idea into practice has found to have absolute relationship with his or her personality (Mumford and Gustafson 1988), and that the creative-oriented personality is indeed exist (Feist 1998), research on exploring such personality so far, unfortunately, is still lacking. Owing to the above claim, which evolved from the finding that difference in personalities are found to have great effects on the operational performance of an organization (Barrick et al. 2003; Hough 2003; Judge and Kristof-Brown 2003), this study therefore rationally infers from the research on personality and operational performance as related to creativity.

The majority of studies have found that neuroticism (Costa and McCrea 1986), extraversion, and conscientiousness are related to the success of operations; the other two are not significant (Hurtz and Donovan 2000). Moreover, neuroticism has a significant effect on overall work performance (Barrick et al. 2001; Hogan and Holland 2003). Others have argued that those who are neurotic are easier experience more negative emotion (Suls et al. 1998) and decreased organization and personal performance (Salgado 1997; Mount et al. 1998).

Extroversion is found to have significant positive relationships with successful operations and age (Melamed 1996a,b). Additionally, those who are extroverts experience high job

satisfaction (Tokar and Subich 1997). However, some research has indicated that the advantages of extraversion are dependent on particular contexts within an organization (Hogan and Holland 2003). Additionally, studies have argued that extroversion has a positive significant relationship with personal performance (Mount et al. 1998).

Based on recent studies' findings, conscientiousness has significant relationships with job performance and successful operation (Timothy et al. 1999). Barrick et al. (2001) claim that conscientiousness has a positive relationship with personal position. Moreover, conscientiousness has a significant positive relationship with job performance and the quality of academic research (Salgado 1997; Paunonen and Ashton 2001; Gray and Watson 2002; Heaven et al. 2002).

Studies have pointed out that openness to experience is crucial in job training and creation (MacKinnon 1960; McCrae 1987; Barrick et al. 2001; George and Zhou 2001; Dollinger et al. 2004; Pruhbu 2006). Studies have found that because those who are agreeable find it easier to get along well with others, agreeableness has a significant positive relationship with successful performance (Hogan and Holland 2003). Some researchers have also indicated that these two personality traits affect personal performance (Mount et al. 1998).

Based on the above studies, this study suggests that except for neuroticism, the rest four personalities can help improve and enhance student creativity in different degree. However, one main question has emerged that also connects directly with the value of this study. Although the above research has indeed revealed which personalities are good for improving and enhancing creativity, these results did not really indicate the creative-oriented personality. This might lead to costs and inefficiency during upgrades to the innovation ability and performance of a university. Therefore, to properly address this difficulty, this study aims to clearly confirm the creative-oriented personality as a point of reference in evaluating the creativity of potential admits to university, to help improve existing students' creativity, and furthermore to help enhance the innovation level and performance of the higher education system. Note that because researchers have found that neuroticism is negatively to operational performance, the remaining four—that is, extraversion, conscientiousness, agreeableness, and openness to experience—are thus extracted for study here.

3 A two-stage MCDM approach

3.1 Fuzzy analytic hierarchy process (FAHP)

Before discussing fuzzy analytic hierarchy process (FAHP), fuzzy set theory needs to address first. Fuzzy set theory was first developed in 1965 when Professor L.A. Zadeh was attempting to solve fuzzy phenomenon problems that exist in the real world: uncertain, incomplete, unspecific, and fuzzy situations. Fuzzy set theory presents certain advantages over traditional set theory in the description of set concepts in human language. It shows unspecific and fuzzy characteristics in language on the evaluation, and it uses a membership function concept to represent the field in which a fuzzy set can permit situations such as “incompletely belonging to” and “incompletely not belonging to.”

While involving fuzzy set theory into researches, fuzzy number plays a critical role for computation. Although types of fuzzy number mainly are two: triangular fuzzy number and trapezoidal fuzzy number (Dubois and Prade 1978), owing to that triangular fuzzy number will be used in this study, we merely introduce it as follow.

We order the Universe of Discourse such that U is a whole target we discuss, and each target in the Universe of Discourse is called an element. Fuzzy \tilde{A} which on U stated that

random $x \rightarrow U$, appointing a real number $\mu_{\tilde{A}}(x) \rightarrow [0, 1]$. We call anything above that level of x under A . The triangular fuzzy number normally represents as $\tilde{A} = (L, M, U)$, where L and U represent fuzzy probability between the lower and upper boundaries of evaluation information, as shown in Fig. 1.

On referring fuzzy number, fuzzy linguistic variable needs to tie in. The fuzzy linguistic variable reflects the different levels of human language. Its value represents the range from natural to artificial language. Variables for a human word or sentence can be divided into numerous linguistic criteria, such as equally important, moderately important, strongly important, very strongly important, and extremely important, as shown in Fig. 2 (with definitions and descriptions as shown in Table 1). For the purposes of the present study, the 5-point scale (as Table 1) is used. Combined fuzzy set theory into analytic hierarchy process (AHP), its calculation steps are five: firstly, compare the performance score; secondly, construct fuzzy comparison matrix; thirdly, examine the consistency of fuzzy matrix; fourthly, calculate fuzzy evaluation of number; fifthly, calculate fuzzy weight; and lastly, de-fuzzy fuzzy weight.

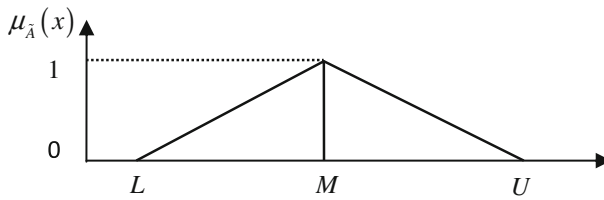


Fig. 1 Triangular fuzzy number

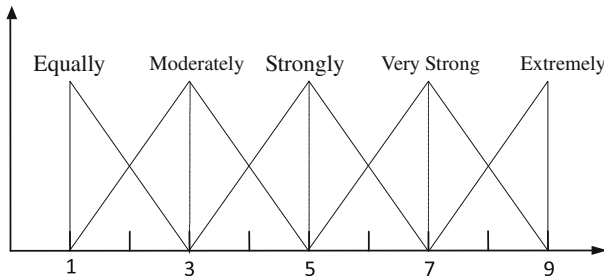


Fig. 2 Fuzzy membership function for linguistic values for attributes

Table 1 Definition and membership function of fuzzy number

| Fuzzy number | Linguistic variable | Triangular fuzzy number |
|--------------|-----------------------------------|-------------------------|
| $\tilde{9}$ | Extremely important/preferred | (7,9,9) |
| $\tilde{7}$ | Very strongly important/preferred | (5,7,9) |
| $\tilde{5}$ | Strongly important/preferred | (3,5,7) |
| $\tilde{3}$ | Moderately important/preferred | (1,3,5) |
| $\tilde{1}$ | Equally important/preferred | (1,1,3) |

3.2 VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR)

The VIKOR method is mainly used to select the best alternative (Opricovic and Tzeng 2004). In the VIKOR method S_j and R_j are used to formulate a ranking measure. The solution gained by $\min_j S_j$ has max group utility, and the solution gained by $\min_j R_j$ has mix individual regret of the “opponent”. The compromise solution F^c is the solution that is the closest to the ideal F^* , and compromise means an agreement established via mutual concessions, which is shown as in Fig. 3 by $\Delta f_1 = f_1^* - f_1^c$ and $\Delta f_2 = f_2^* - f_2^c$ (Opricovic and Tzeng 2004).

There are five VIKOR calculation steps as follows (Tzeng et al. 2002; Opricovic and Tzeng 2004; Tzeng et al. 2005; Opricovic and Tzeng 2007):

- Step 1. Decide the best f_i^* and the worst f_i^- values of all criterion functions $i = 1, 2, \dots, n$. It can be solved by Eq. (11).

$$f_i^* = \max_j f_{ij}, f_i^- = \min_j f_{ij} \tag{11}$$

- Step 2. Calculate the values S_j and R_j ; $j = 1, 2, \dots, J$ using the Eqs. (12) and (13).

$$S_j = \sum_{i=1}^n w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-) \tag{12}$$

$$\text{and } R_j = \max_i [w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-)] \tag{13}$$

where w_i are the weights of the criteria, expressing their relative importance.

- Step 3. Calculate the values Q_j , $j = 1, 2, \dots, J$ via Eq. (14).

$$Q_j = v (S_j - S^*) / (S^- - S^*) + (1 - v)(R_j - R^*) / (R^- - R^*), \tag{14}$$

$$S^* = \min_j S_j, \quad S^- = \max_j S_j$$

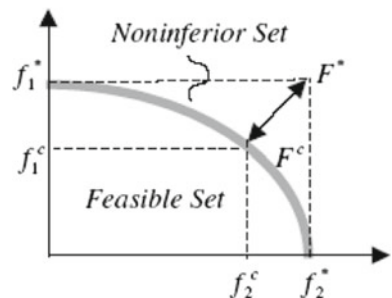
$$R^* = \min_j R_j, \quad R^- = \max_j R_j.$$

and v is introduced as the weight of the strategy of the maximum group utility, here $v = 0.5$.

- Step 4. Alternatives ranking, sorted by the values S, R and Q , in decreasing order. The result is three ranking lists.

- Step 5. We propose as a compromise solution the alternative (d), ranked the best by the measure Q (min) if it satisfies the following two conditions:

Fig. 3 Ideal and compromise solutions



1. $Q(a'') - Q(a') \geq DQ$, which called acceptable advantage where a'' is the alternative with second position in the ranking list by $DQ = 1/(J - 1)$; J is the number of alternatives.
2. Acceptable stability in decision making: Alternative d has to also be the best ranked by S or/and R . This solution is stable in a decision-making process that could be characterized as “voting by majority rule” (when $v > 0.5$ is needed) or “by consensus” $v \approx 0.5$, or “with veto” ($v < 0.5$). Here, v is the weight of the decision-making strategy the max group utility.

4 An empirical study

4.1 The research hierarchical structure development for the evaluation

It is difficult to develop the research hierarchical structure for creativity and personality because such a structure ought to fit the real practice. As noted previously, to make the results less biased, we used the creativity measurement structure focusing on college students constructed by Wu et al. in 2009 after conscientious investigation and a thorough literature review and the categorization of expert opinions (Wu et al. 2009). To increase the level of reliability of the research, the creativity measurement structure is further validated by 15 senior educational background experts (3 from research-intensive universities, 3 from professional-intensive universities, 3 from research & teaching-intensive universities; 3 from teaching-intensive universities, and 3 from education-in-practice-intensive universities). In addition, as for personality, this study adopts the “Big Five” concept (Costa and McCrea 1986) and discards one personality, neuroticism, due to its lesser creative potential; we make inferences with regard to the relationship between operation performance and personality based on the majority of studies. The research hierarchical structure is finally developed as shown in Table 2.

To confirm the most creative personality type as a point reference for admitting creative students in the future, to help improve existing students’ creativity, and to help enhance the level of innovation and performance of the higher education system, the FAHP is initially used to compute the relative weights of evaluation creativity criteria; after that, VIKOR is utilized to rank the creative score for each personality based on the relative weight of each creativity criterion.

After the development of the hierarchical research structure, 60 expert questionnaires were forwarded to senior university faculties. Of these, 37 were returned, of which 6 were discarded for statistical reasons. The overall response rate was 52%, with a total of 31 questionnaires employed for analysis.

Among the 31 sample senior experts, 20 (65%) were male and 11 (35%) were female. The background groups are professor (59%), associate professor (23%), and assistant professor (18%). Additionally, 22% of respondents were from research-intensive universities, 27% of respondents were from professional-intensive universities, 43% of respondents were from research & teaching-intensive universities; 6% of respondents were from teaching-intensive universities, and 2% of respondents were from education-in-practice-intensive universities.

Their weightings used the 5-point scale provided in Table 1 to evaluate the importance of creativity dimensions and criteria. As for the creativity scores for the four personalities, scores within a range from 5 (the best) to 1 (the worst) were provided based on the senior experts’ professional perceptions.

Table 2 The research hierarchical structure

| Goal | Evaluation dimensions | Evaluation criteria | Personalities |
|--|--|---|-----------------------------|
| Admitting right students (The most creative personality) | Personality trait (D1) | Knowledge learning (C1) | Extroversion (P1) |
| | | Self motivation (C2) | |
| | | Personal characteristics (C3) | Conscientiousness (P2) |
| | University effect (D2) | University climate (C4) | |
| | | Interaction between student and faculty (C5) | |
| | | Student interaction (C6) | Agreeableness (P3) |
| | Family influence (D3) | Family living style (C7) | |
| | | Parents' ways of fostering children (C8) | |
| | | Children's recognition of learning model (C9) | Openness to experience (P4) |
| | Society education and interaction (D4) | Culture-level influence (C10) | |
| | | Education-level enhancement (C11) | |

4.2 Weighting evaluation creativity dimensions and criteria with the FAHP

Initially, both the global weight of the evaluation creativity dimensions and the local weights of evaluation creativity criteria were computed along with fuzzy measuring matrices. All pairwise comparisons are in accordance with Saaty's 5-point scale (see Table 1); that is, a scale ranges from 1 (equally important) to 9 (extremely important). After all of the steps in the FAHP analysis were completed, the global weights of the 4 evaluation creativity dimensions and local weights for 11 evaluation creativity criteria were determined. Then, to obtain the global weights of the evaluated creativity criteria, the global weight of each creativity dimension with follow computation steps of FAHP, global weights for the evaluation creativity criteria were therefore analyzed. In Table 3, the results of all FAHP analyses are summarized. Based on the result, personality trait ($w = 0.506$) indeed is believed to be the top concern to impact the improvement of students' creativity. Meanwhile, the top five creativity measurement criteria which is deemed to have highly influence on improving students' creativity: Knowledge Learning ($w = 0.322$), Personal Characteristics ($w = 0.119$), Parents' ways of fostering Children ($w = 0.110$), Interaction between Student and Faculty ($w = 0.106$), and Education-level Enhancement ($w = 0.077$).

4.3 Confirming the most creative personality using VIKOR

To confirm the most creative personality, VIKOR analysis is conducted to score the creativity performance of the four personalities in accordance with the global weights of the creativity criteria for evaluation (See Table 3). This is because all of the criteria are non-quantifiable; to ensure a less biased result, a range from 5 (the best) to 1 (the worst) is provided based on

Table 3 The summarized results of FAHP analyses

| Evaluation creativity dimensions/ criteria | BNP | Local weight ^a | Global weight ^b | Global ranking ^c |
|---|-------|---------------------------|----------------------------|-----------------------------|
| Personality trait (D1) | 0.687 | 0.506 | | 1 |
| Knowledge learning (C1) | 0.836 | 0.627(1) | 0.322 | 1 |
| Self motivation (C2) | 0.188 | 0.141(3) | 0.072 | 7 |
| Personal characteristics (C3) | 0.308 | 0.231(2) | 0.119 | 2 |
| University effect (D2) | 0.230 | 0.169 | | 3 |
| University climate (C4) | 0.186 | 0.152(3) | 0.024 | 11 |
| Interaction between student and faculty (C5) | 0.822 | 0.671(1) | 0.106 | 4 |
| Student interaction (C6) | 0.218 | 0.178(2) | 0.028 | 10 |
| Family influence (D3) | 0.316 | 0.233 | | 2 |
| Family living style (C7) | 0.410 | 0.328(2) | 0.073 | 6 |
| Parents' ways of fostering children (C8) | 0.618 | 0.493(1) | 0.110 | 3 |
| Children's recognition of learning model (C9) | 0.225 | 0.180(3) | 0.040 | 8 |
| Society education and interaction (D4) | 0.126 | 0.093 | | 4 |
| Culture-level influence | 0.415 | 0.276(2) | 0.029 | 9 |
| Education-level enhancement (C11) | 1.088 | 0.724(1) | 0.077 | 5 |

Parenthesis indicates the local ranking within each dimension

^a Standardized BNP

^b Obtained by multiplying both local weights of the criterion and its dimension

^c Ranked based on global weights

Table 4 The average of the original creativity scores given by senior experts

| Alternatives (personality) | Personality trait (D1) | | | University effect (D2) | | | Family influence (D3) | | Society education and interaction (D4) | | | Total ^a |
|----------------------------|------------------------|------|------|------------------------|------|------|-----------------------|------|--|------|------|--------------------|
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | |
| P 01 | 4.17 | 3.57 | 3.93 | 3.78 | 4.12 | 4.33 | 3.59 | 4.06 | 4.18 | 3.82 | 3.33 | 42.88 |
| P 02 | 3.01 | 2.47 | 2.56 | 2.87 | 2.43 | 3.22 | 3.16 | 2.19 | 2.34 | 3.07 | 2.98 | 30.30 |
| P 03 | 3.26 | 3.17 | 3.99 | 4.06 | 3.22 | 2.59 | 2.98 | 3.06 | 3.41 | 2.95 | 3.35 | 36.04 |
| P 04 | 4.23 | 4.69 | 4.37 | 4.51 | 3.98 | 3.79 | 4.55 | 4.37 | 3.69 | 4.03 | 4.11 | 46.32 |

^a Un-weighted total score of performance value

the professional perceptions of senior experts. First, the original scores provided in Table 4 are determined by averaging all (31) senior experts' scores. To achieve the highest aspired-to level (Opricovic and Tzeng 2002), it is advisable to set f_i^* to 5 (the best) and f_i^- to 1 (the worst) instead of using Eq. 11. From Eqs. 12–13, S_j and R_j are then calculated. Then, the value of Q is acquired by adopting Eq. 14 and setting 0.5 for v , voting by consensus. Finally, in accordance with Q values, the rankings of the 4 personalities are obtained and the creative-oriented personality is thus confirmed. The results of the VIKOR measurement and ranking of personalities are summarized in Table 5. In accordance with the result, Openness

Table 5 VIKOR evaluation results and ranking of personalities

| Evaluation creativity criteria | Creativity evaluation ^b | | | | PIS/ NIS | | Relative weight w_i^a |
|--------------------------------|------------------------------------|--------|--------|--------|----------|---------|----------------------------|
| | P01 | P02 | P03 | P04 | f_i^* | f_i^- | |
| C1 | 0.016 | 0.322* | 0.256* | 0.000 | 5 | 1 | 0.322 |
| C2 | 0.036 | 0.072 | 0.049 | 0.000 | 5 | 1 | 0.072 |
| C3 | 0.029 | 0.119 | 0.025 | 0.000 | 5 | 1 | 0.119 |
| C4 | 0.011 | 0.024 | 0.007 | 0.000 | 5 | 1 | 0.024 |
| C5 | 0.001 | 0.106 | 0.057 | 0.009 | 5 | 1 | 0.106 |
| C6 | 0.000 | 0.018 | 0.028 | 0.009 | 5 | 1 | 0.028 |
| C7 | 0.045 | 0.065 | 0.073 | 0.000 | 5 | 1 | 0.073 |
| C8 | 0.016 | 0.110 | 0.066 | 0.000 | 5 | 1 | 0.110 |
| C9 | 0.000 | 0.040 | 0.017 | 0.011* | 5 | 1 | 0.040 |
| C10 | 0.006 | 0.026 | 0.029 | 0.000 | 5 | 1 | 0.029 |
| C11 | 0.053* | 0.077 | 0.052 | 0.000 | 5 | 1 | 0.077 |
| S_j | 0.211 | 0.978 | 0.658 | 0.029 | | | |
| R_j | 0.053 | 0.322 | 0.256 | 0.011 | | | |
| Q_j | 0.164 | 1.000 | 0.725 | 0.000 | | | |
| Rank ^c | 2 | 4 | 3 | 1 | | | |

The * symbol represents the worst performance of the 11 evaluation criteria for every personality’s creativity evaluation values

^a The weight of each performance evaluation criteria (as shown in Table 8)

^b Obtained from $w_i \frac{|f_i^* - f_{ij}|}{|f_i^* - f_i^-|}$ (the weighted value of the arithmetic average of the original performance evaluation values given by the experts).

^c Rankings based on the rules (the smaller the value of Q_j , the better it is)

to experience ($Q = 0.000$) is believed to be the creative-oriented personality. Following are Extroversion ($Q = 0.164$), Agreeableness ($Q = 0.725$), and the less creative-oriented personality is Conscientiousness ($Q = 1.000$).

5 Discussion and implications

In today’s highly changing and dynamic world, industries in every country have no choice but to face competitive pressures worldwide. Because innovation has essentially become an imperial edict dictating firms’ chances for survival (Daft 2004; Krause 2004), how to enhance innovative ability and performance has become a critical issue for governments and researchers globally. It is true that potential ways of enhancing innovation are numerous; among them, however, a focus on fostering and applying knowledge creation is believed to help foster long-lasting competitive advantage in terms of organizational innovation and performance (Gardiner 1993).

The higher education system, a system that is believed to be a core of novel knowledge creation for each country, thus plays a critical role in improving a nation’s innovative ability and performance due to its ability to foster high-tech talent, to increase national quality, and to upgrade the national competitive advantage (Fairweather 2000; Meek 2000; Chen and Chen 2010a,b,c)

However, as noted before, the higher education system in Taiwan is currently at great risk of losing competitive advantage, not to mention to be a kingdom of innovation, the national goal in the future, which results from both domestic and international environment pressures. Therefore, regaining innovative level and performance to further re-build national competitive advantage is an urgent issue that must be addressed in a timely manner.

This study is based on the idea that creativity is the basis of innovation (Dewett and Gruys 2007), that personality is found to have great influence on operation performance (Barrick et al. 2003; Hough 2003; Judge and Kristof-Brown 2003), that one who cannot generate creative idea as well as make creative idea into practice has found to have absolute relationship with their personality (Mumford and Gustafson 1988), and that students are a major group that is already deemed to be the backbone of the nation's future development (Chen and Chen 2010a,b,c), as well as the suggestion that admitting creativity-oriented students is better than just improving all students' creativity in terms of increasing a university's innovation level and performance efficiently and for the long term (Gilbert et al. 1996; Driver 2001; Allison 2004; Hervani and Helms 2004; Wynder 2004; Chen and Chen 2009a,b). In this regard, the aims of this study are to confirm the creative-oriented personality as a point of reference for future admissions processes that may include some consideration of creativity, to help improve existing students' creativity levels, and finally to help enhance the innovation level and performance of the higher education system, which rarely earns the attention it deserves.

In accordance with the research results, Knowledge Learning (C1), Personal Characteristics (C3), Interaction between Student and Faculty (C5), Parents' Ways of Fostering Children (C8), and Education-level Enhancement (C11) are the top five creativity criteria that are believed to have a positive effect on college students' creativity levels. In addition, most importantly of all, with regard to personality, Openness to Experience (P4) is confirmed as the creative-oriented personality. It is also noteworthy that we further identify the creative-oriented personality based on the mainstream researches of discussing the relationship between personality and creativity which is one of major contributions we made for current literature. Besides, the methodologies we used also confirm the validity of the result. Current researches heavily based on subordinate level (Chen and Chen 2008), that is, self-report, instead of on manager level, which is lack of objectivity. In this study, all measurement is based on a sample of senior educational background experts from all types of universities which could not merely decrease the risk of each expert's verbal stereotype but also increase the validity of findings of previous researches. Using the results, we can consider two areas for directive type discussion regarding how to comprehensively improve and enhance the innovation level and performance of the higher education system: considering admitting students with high levels of creativity or creative potential; and improving existing students' creativity.

Indeed, based on these results, it is obvious that of the four personalities, Openness to Experience (P4) is the only one that achieves a satisfying level of performance. Therefore, in considering which possible applicants should be admitted, we might suggest that those who exhibit Openness to Experience (P4) are encouraged to put on the top concern. As for how to tell which applicants exhibit Openness to Experience (P4), in accordance with NEO personality examination, Openness to Experience (P4) contains sensitivities of imagination, feeling, esthetics, thought, behavior, and value (McCrae 1987), which we could integrate into one new concept, multi-consciousness-dimensional divergent sensitivity, thus the top five creativity criteria are critical guidelines to distinguish due to their significant influences not merely on creativity and evaluation and improvement but also on personality which proposed by both practice and academy (Runco 2008). First, before one converts a novel idea into a practice, identifying this idea as constructive is important. There is an old saying that

things are always easier said than done. One who lacks sufficient knowledge may never act on his ideas. With this danger in mind, an interviewer could develop diverse questions for the interviewee (applicant), such as questions based on the latest news reports, case studies, issue debates, and problem-solving with brainstorming, to examine how extensive are the types of knowledge that an applicant has. On the other hand, to improve existing students' creativity and ensure that their novel ideas are useful, ways of helping them continuously develop their knowledge, such as the latest information update, should not be forgotten. The same strategies utilized in the interview process could also be adapted for use in training existing students to improve their creativity (Wallach and Kogan 1965).

In addition, Personal Characteristics (C3) is also critical. All those who demonstrate Openness to Experience (P4) do not necessarily display the same level of creativity or the same type. Besides, Maslow (1968) also indicated that the creativity of self-actualization for each person is natural and easy to see in life which has also been supported by recent empirical studies (Runco et al. 1991). We could rationally infer that personal characteristics could make creativity outcome with differentiation. Therefore, the interviewer should always keep in mind that those applicants who lack certain Personal Characteristics (C3) might easily accept creativity enhancement but not be creative. The best way to distinguish between students in this regard is to consider which applicants forcefully present their opinions and negatively judge those opinions that are contrary to their own. Similarly, among existing students, shaping Personal Characteristics (C3) is an optimal way to enhance creativity. Universities are encouraged to develop multiple-adaptive forms of examination to determine students' characteristics. By offering appropriate and diverse classes—for example, by increasing optional course opportunities based on the results of the examination—universities could foster students' Personal Characteristics (C3). Such consequences could directly improve students' creativity and development (Chen and Chen 2010a,b,c).

Students who initiate interaction with their teachers are believed to enjoy a high level of self-confidence. Because creativity and self-confidence create a loop in which they support each other, it could be rationally concluded that an applicant who dares to interact boldly with the interviewer, to represent his opinions and demonstrate a certain charisma during the interview process, has a high level of creativity. Therefore, interviewers are strongly advised to accept such applicants, tapping into the cycle and putting human creativity into practice (Williamson 2001) to ensure future innovation and continuously increasing performance on the part of the university. With regard to existing students, adopting an open and free style (Wallach and Kogan 1965) and/or an activity-oriented style in class rather than a lecture style is encouraged as significantly increasing the opportunity for Interaction between Student and Faculty (C5) (Chen and Chen 2010a,b,c). These two tactics should be especially beneficial in upgrading students' creativity with unconsciousness.

It is a truth confirmed by both academic research and scientific reports that Parents' Ways of Fostering Children (C8) can greatly affect the development and life-value and creativity of a child (Cropley 1967; Hitchfield 1973). Because modesty and silence are two of the cultural values prevalent in Asia, no matter what strategies parents choose in fostering their children, they mainly choose to teach their children silence and inaction in class, especially in the higher education system (Chen and Chen 2010a,b,c). Such a phenomenon has no doubt always decreased children's creativity. To interviewers at a university, we suggest that examining parents' background may prove helpful. However, because it is hard to tell if an applicant has Openness to Experience (P4) directly via this approach, interviewers could also appropriately pursue the family-oriented issue to infer whether the applicant was raised under conscientious, strict, or a related mode of discipline and thus to infer whether this applicant has creative potential. As for existing students, universities are strongly advised to periodically

connect with students' parents and examine changes in students' behavior. This is because depression can destroy creativity (Cox 2008). Emphasizing such attentions could either prevent possible creativity loss or uncover optimal ways to cultivate students' creative potential.

Applicants do not always have the same level of academic background, even if they exhibit Openness to Experience (P4). With this in mind, Educational-level Enhancement (C11) becomes one of the top creativity criteria in accordance with the professional perceptions and experiences of senior educational experts; interviewers therefore should place emphasis on those who have already acquired higher-level or/and more diverse educational background. This is because, as this study has concerned, the more knowledge a person has, the more creativity he displays, so that educational background can thus be used to tell whether an applicant is creative. With regard to existing students, by promoting graduates applying higher degree or supporting students to become exchange students are good ways to enhance students' education-level.

In general, although the Openness to Experience (P4) personality is deemed the creative-oriented creativity, it should be noted that different people have different levels of Openness to Experience (P4). Additionally, this level may change over time or be affected by other variances. To preserve innovative level and enhance performance, focusing on considering admitting possible creative students, universities should always pay more attention to applicants who exhibit Openness to Experience (P4), especially during the interview process. Additionally, improving existing students' creativity by taking the top five creativity criteria into account is highly advisable, as this will allow universities to accomplish such improvements efficiently and at no cost.

Additionally, because it is impossible that applicants will be largely of the Openness to Experience (P4) personality, another contribution of this study for practice is that it provides a ranking for the other kinds of personality with regard to their effect on creativity; once the applicants who exhibit Openness to Experience (P4) have been admitted, the interviewers are encouraged to admit applicants based on this ranking. In addition, because confirming which personality is the most creative and the discussion and implications stemming from this effort have largely been the focus of this study, there has been a lack of discussion regarding the implications of the remaining four. Future research should discuss the remaining four personalities, in accordance with the two-fold focus above, to help the higher education system improve and to comprehensively enhance innovative ability and performance. Lastly, owing to that the focus of this study is to provide clear and directive type discussion of how innovation level of the university can be enhanced via the admission of creative-oriented students and the improvement of existing students' creativity, future researches are advised to further investigate the creative outcome of after utilizing proposed suggestions of this study for each type of university.

6 Conclusion

As the world becomes more and more competitive and dynamic, innovation is becoming key to the survival of an organization. Because developing and applying knowledge is regarded as key to long-lasting innovative level and improved performance, higher education systems play an important role in determining a nation's innovative level and performance. Unfortunately, the higher education system has not held up as desired in the face of competitive pressures. Therefore, regaining innovative level and performance to re-build national competitive advantage is becoming an urgent issue that must be addressed in the short term. Considering that creativity is the basis of innovation (Dewett and Gruys 2007), that one who

cannot generate creative idea as well as make creative idea into practice has found to have absolute relationship with their personality (Mumford and Gustafson 1988), that personality is found to have a great influence on operation performance (Barrick et al. 2003; Hough 2003; Judge and Kristof-Brown 2003), and that students are a major group who have already been deemed to be the backbone of future nation-building (Chen and Chen 2010a,b,c), this study aims to confirm the creative-oriented personality as a point of reference for potentially admitting more creative students in the future over less creative ones. The goal has also been to help improve existing students' creativity and, furthermore, to help enhance the innovation level and performance of the higher education system. To help comprehensively improve innovation level and performance, this discussion and its implications have espoused a two-fold focus, considering both how to admit more creative students and how to improve existing students' creativity. The value of this study is that it is the first research to confirm the creative-oriented personality, which is highly necessary for the survival of today's universities. The contribution of this study is both in improving creativity by admitting more creative students and in doing so by improving existing students' creativity; these ideas are discussed to comprehensively support the higher education system to improve and enhance innovation level and performance efficiently, at no cost, and (most importantly) for the long term.

References

- Allison, D.: Creativity, students' academic writing, and EAP: exploring comments on writing in an English language degree programme. *J. English Acad. Purp.* **3**, 191–209 (2004)
- Amabile, T.M.: A model of creativity and innovation in organizations. In: Staw, B.M., Cummings, L.L. (eds.) *Research in Organizational Behavior*, pp. 123–167. JAI, Greenwich, CT (1988)
- Barrick, M.R., Mount, M.K., Judge, T.A.: Personality and performance at the beginning of the new millennium: What do we know and where do we go next?. *Personal. Perform.* **9**, 9–30 (2001)
- Barrick, M.R., Mitchell, T.R., Stewart, G.L.: Situational and motivational influences on trait-behavior relationships. In: Barrick, M.R., Ryan, A.M. (eds.) *Personality and work: reconsidering the role of personality in organizations*, pp. 60–82. Jossey-Bass, San Francisco (2003)
- Batey, M.D.: A psychometric investigation of everyday creativity. Unpublished doctoral thesis, University of London (2007)
- Bharadwaj, S., Menon, A.: Making innovation happen in organizations: individual creativity mechanisms, organizational creativity mechanisms or both?. *J. Prod. Innov. Manag.* **17**, 424–434 (2000)
- Chen, J.K., Chen, I.S.: Personal traits and leadership styles of Taiwan's higher educational institutions in innovative operations. *J. Am. Acad. Bus. Cambridge* **12**(2), 145–150 (2008)
- Chen, J.K., Chen, I.S.: An empirical study of the relationships between leader, member, and innovative operation in high tech industry. *J. Organ. Cult. Commun. Confl.* **13**(1), 21–33 (2009a)
- Chen, J.K., Chen, I.S.: TQM measurement model for biotechnology industry in Taiwan. *Exp. Syst. Appl.* **36**(5), 8789–8798 (2009b)
- Chen, I.S., Chen, J.K.: Improvement in national innovation: student creativity and innovative universities. Manuscript submitted to a journal (2010a)
- Chen, I.S., Chen, J.K.: To be a creative student: a study on the secondary education system. Manuscript submitted for publication (2010b)
- Chen, J.K., Chen, I.S.: A Pro-performance appraisal system for the university. *Exp. Syst. Appl.* **37**, 2108–2116 (2010c)
- CNA: Taiwan Breaking News. Retrieved August 8, 2009, (2009a) from http://gov.cna.com.tw/ReadNews/FeatureNews_Read.aspx?TopicNo=86&ID=200901170227
- CNA: Taiwan Breaking News. Retrieved August 8, 2009, (2009b) from http://gov.cna.com.tw/ReadNews/FeatureNews_Read.aspx?TopicNo=86&ID=200901170030&pageNum=1
- Costa, P.T., McCrea, R.R.: Four ways five factors are basic. *Personal. Individ. Differ.* **13**, 653–665 (1986)
- Cox, S.: How to unleash your creativity. *Balanced existence*. Retrieved December 01, 2009 (2008) from <http://www.pickthebrain.com/blog/unleash-your-creativity/>
- Cropley, A.J.: *Creativity*. Longmans, Green, London (1967)

- Daft, R.L.: *Organization theory & design*. West, NY (2004)
- Dewett, T., Gruys, M.L.: Advancing the case for creativity through graduate business education. *Think. Skills Creat.* **2**, 85–95 (2007)
- DiPietro, W.R., Anoruo, E.: Creativity, innovation, and export performance. *J. Pol. Model.* **28**, 133–139 (2006)
- Dollinger, S.J., Urban, K.K., James, T.J.: Creativity and openness: further validation of two creative product measures. *Creat. Res. J.* **16**, 35–48 (2004)
- Driver, M.: Fostering creativity in business education: developing creative classroom environments to provide students with critical workplace competencies. *J. Educ. Bus.* 28–33 (2001)
- Dubois, D., Prade, H.: Operations on fuzzy number. *Int. J. Syst. Sci.* **9**(3), 613–626 (1978)
- Fairweather, J.S.: Diversification or homogenization: How markets and governments combine to shape American higher education. *Higher Educ. Pol.* **13**, 79–98 (2000)
- Feist, G.: A meta-analysis of personality in scientific and artistic creativity. *Personal. Soc. Psychol. Rev.* **4**, 290–304 (1998)
- Friedman, H.S., Tucker, J.S., Schwartz, J.E., Martin, L.R., Tomlinson-Keasey, C., Wingard, D.L., Criqui, M.H.: Childhood conscientiousness and longevity: health behaviors and the cause of death. *J. Personal. Soc. Psychol.* **68**, 696–703 (1995)
- Funder, D.C.: *The personality puzzles*. 2nd edn. Norton, NY (2001)
- Furnham, A., Batey, M., Anand, K., Manfield, J.: Personality, hypomania, intelligence and creativity. *Personal. Individ. Diff.* **44**, 1060–1069 (2008)
- Gardiner, H.: *Creating minds*. Basic Books, NY (1993)
- George, J.M., Zhou, J.: When openness to experience and conscientiousness are related to creative behavior: an interaction approach. *J. Appl. Psychol.* **86**, 513–514 (2001)
- Gilad, B.: Entrepreneurship: the issue of creativity in the market place. *J. Creat. Behav.* **18**, 151–161 (1984)
- Gilbert, F.W., Prenshaw, P.J., Ivy, T.T.: A preliminary assessment of the effectiveness of creativity training in marketing. *J. Market. Educ.* **18**, 46–56 (1996)
- Gray, E.K., Watson, D.: General and specific traits of personality and their relation to sleep and academic performance. *J. Personal.* **70**, 177–206 (2002)
- Heaven, P.C.L., Mak, A., Barry, J., Ciarrochi, J.: Personality and family influences on adolescent attitudes to school and self-rated academic performance. *Personal. Individ. Diff.* **32**, 453–462 (2002)
- Hervani, A., Helms, M.M.: Increasing creativity in economics: the service learning project. *J. Educ. Bus.* 267–274 (2004)
- Hitchfield, E.M.: *In search of promise*. William Clowes & Sons, London (1973)
- Hogan, J., Holland, B.: Using theory to evaluate personality and job performance relations: a socioanalytic perspective. *J. Appl. Psychol.* **88**, 100–112 (2003)
- Hough, L.M.: Emerging trends and needs in personality research and practice: beyond main effects. In: Barrick, M.R., Ryan, A.M. (eds.) *Personality and work: reconsidering the role of personality in organizations*, pp. 289–325. Jossey-Bass, San Francisco (2003)
- Hsieh, T.Y., Lu, S.T., Tzeng, G.H.: Fuzzy MCDM approach for planning and design tenders selection in public office buildings. *Int. J. Project Manag.* **22**, 573–584 (2004)
- Hurtz, G.M., Donovan, J.J.: Personality and job performance: the big five revisited. *J. Appl. Psychol.* **85**(6), 869–879 (2000)
- Judge, T.A., Kristof-Brown, A.L.: Personality, interactional psychology, and person-organization fit. In: Schneider, B., Smith, D.B. (eds.) *Personality and organizations*, pp. 126–161. Erlbaum, Mahwah, NJ (2003)
- Judge, T.A., Heller, D., Mount, M.: Five-factor model of personality and job satisfaction: a meta-analysis. *J. Appl. Psychol.* **87**(3), 530–541 (2002)
- Kaufman, J.C., Lee, J., Baer, J., Lee, S.: Captions, consistency, creativity, and the consensual assessment technique: new evidence of reliability. *Think. Skills Creat.* **2**, 96–106 (2007)
- Krause, D.E.: Influence-based leadership as a determinant of the inclination to innovative and of innovate-related behavior: an empirical investigation. *Leadersh. Q.* **15**, 79–102 (2004)
- MacKinnon, D.W.: The highly effective individual. In: Albert, R.S. (ed.) *Genius and eminence: the social psychology of creativity and exceptional achievement*, pp. 114–127. Pergamon, Oxford (1960)
- Magee, G.B.: Rethinking invention: cognition and the economics of technological creativity. *J. Econ. Behav. Organ.* **57**, 29–48 (2005)
- Maslow, A.: Creativity in self-actualizing people. In: *Toward a psychology of being*, pp. 135–145. Van Nostrand Reinhold, NY (1968)
- McCloskey, D.N.: 1066 and a Wave of Gadgets: the Achievements of British Growth. In: Gouk, P. (ed.) *Wellsprings of achievement: cultural and economic dynamics in early modern England and Japan*, pp. 114–132. Aldershot, Variorum (1995)

- McCrae, R.R.: Creativity, divergent thinking, and openness to experience. *J. Personal. Soc. Psychol.* **52**, 1258–1265 (1987)
- Meek, V.L.: Diversity and marketisation of higher education: incompatible concepts. *Higher Educ. Pol.* **13**, 23–39 (2000)
- Melamed, T.: Career success: an assessment of a gender-specific model. *J. Occup. Organ. Psychol.* **69**, 211–242 (1996)
- Melamed, T.: Validation of a stage model of career success. *Appl. Psychol. Int. Rev.* **45**, 35–45 (1996)
- Mikhailov, L.: Deriving priorities from fuzzy pairwise comparison judgements. *Fuzzy Sets Syst.* **134**, 365–385 (2003)
- Mohr, L.: *Explaining Organizational Behavior*. Jossey-Bass, San Francisco (1982)
- Mount, M.K., Barrick, M.R., Stewart, G.L.: Five-factor model of personality and performance in jobs involving interpersonal interactions. *Human Perform.* **11**, 145–165 (1998)
- Mozart, E.N.: *Portrait of a Genius*. Polity Press, Cambridge, UK (1993)
- Mumford, M.D., Gustafson, S.B.: Creativity syndrome: integration, application, and innovation. *Psychol. Bull.* **103**, 27–43 (1988)
- Mumford, M.D.: Managing creative people: strategies and tactics for innovation. *Hum. Resour. Manag. Rev.* **3**(3), 313–351 (2000)
- Oldham, G.R., Cummings, A.: Employee creativity: personal and contextual factors at work. *Acad. Manag. J.* **39**, 607–634 (1996)
- Opricovic, S., Tzeng, G.H.: Multicriteria planning of Post-Earthquake sustainable reconstruction. *J. Comput. Aided Civil Infrastruct. Eng.* **17**(2), 211–220 (2002)
- Opricovic, S., Tzeng, G.H.: Compromise solution by MCDM methods: a comparative analysis of VIKOR and TOPSIS. *Eur. J. Oper. Res.* **156**, 445–455 (2004)
- Opricovic, S., Tzeng, G.H.: Extended VIKOR method in comparison with outranking methods. *Eur. J. Oper. Res.* **178**, 514–529 (2007)
- Paunonen, S.V., Ashton, M.C.: Big Five predictors of academic achievement. *J. Res. Personal.* **35**, 78–90 (2001)
- Persaud, R.: Why teaching creativity requires more than just producing more 'creativity'. *Think. Skills Creat.* **2**, 68–69 (2007)
- Pruhbu: Creativity and certain personality traits: understanding the mediating effect of intrinsic motivation. Manuscript submitted for publication (2006)
- Roberts, B.W., DelVecchio, W.F.: The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. *Psychol. Bull.* **126**, 3–25 (2000)
- Runco, M.A.: *Creativity: Theories and Themes: Research, Development, and Practice*. Elsevier, USA (2008)
- Runco, M.A., Ebersole, P., Mraz, W.: Self-actualization and creativity. *J. Soc. Behav. Personal.* **6**, 161–167 (1991)
- Salgado, J.F.: The five factor model of personality and job performance in the European Community. *J. Appl. Psychol.* **82**, 30–43 (1997)
- Shalley, C.E.: Effects of productivity goals, creativity goals, and personal discretion on individual creativity. *J. Appl. Psychol.* **76**, 179–185 (1991)
- Sternberg, R.J.: *The Nature of Creativity: Contemporary Psychological Perspectives*. Cambridge University Press, Cambridge, UK (1988)
- Sternberg, R.J.: *The Nature of Cognition*. MIT Press, Cambridge, MA (1999)
- Suls, J., Green, P., Hillis, S.: Emotional reactivity to everyday problems, affective inertia, and neuroticism. *Personal. Soc. Psychol. Bull.* **24**, 127–136 (1998)
- Taiwan Assessment and Evaluation Association: *Evaluation Bimonthly*, 1, 48–49 (2006)
- Taylor, C.W.: Various Approaches to and Definitions of Creativity. In: *The Nature of Creativity: Contemporary Psychological Perspectives*. Cambridge University Press, Cambridge, UK (1988)
- Timothy, A.J., Chad, A.H., Carl, J.T., Murry, R.B.: The big five personal traits, general mental ability, and career success across the life span. *Pers. Psychol.* **52**, 621–652 (1999)
- Tokar, D.M., Subich, L.M.: Relative contributions of congruence and personality dimensions to job satisfaction. *J. Vocat. Behav.* **50**, 482–491 (1997)
- Torrence, E.P.: The nature of creativity as manifest in its testing. In: Sternberg, R.J. (ed.) *The Nature of Creativity: Contemporary Psychological Views*, pp. 43–75. Cambridge University Press, Cambridge, UK (1988)
- Tzeng, G.H., Lin, C.W., Opricovic, S.: Multi-criteria analysis of alternative-fuel buses for public transportation. *Energy Pol.* **33**, 1373–1383 (2005)
- Tzeng, G.H., Teng, M.W., Chen, J.J.: Multicriteria selection for a restaurant location in Taipei. *Hosp. Manag.* **21**, 171–187 (2002)
- Wallach, M.A., Kogan, N.: *Modes of Thinking in Young Children*. Holt, Rinehart, & Winston, NY (1965)
- Ward, T.B.: Cognition, creativity, and entrepreneurship. *J. Bus. Ventur.* **19**, 173–188 (2004)

- Weifens, P., Addison, J., Audretsch, D., Gries, T., Grupp, H.: *Globalization, Economic Growth and Innovation Dynamics*. Springer, NY (2000)
- Weiner, R.P.: *Creativity & Beyond: Cultures, Values, and Change*. State University of New York Press, Albany, NY (2000)
- Whiting, B.G.: Creativity and entrepreneurship: how do they relate?. *J. Creat. Behav.* **22**, 178–183 (1988)
- Williamson, B.: Creativity, the corporate curriculum and the future: a case study. *Futures* **33**, 541–555 (2001)
- Wolfradt, U., Pretz, J.: Individual differences in creativity: personality, story writing, and hobbies. *Eur. J. Personal.* **15**, 297–310 (2001)
- Woodman, R.W., Sawyer, J.E., Griffin, R.W.: Toward a theory of organizational creativity. *Acad. Manag. Rev.* **18**, 293–321 (1993)
- Wu, H.Y., Chen, H.C., Huang, R.J.: A study on the critical evaluation factors of creativity for college students. Manuscript submitted to a journal (2009)
- Wynder, M.: Facilitating creativity in management accounting: a computerized simulation. *Account. Educ.* **13**, 150–231 (2004)
- Zadeh, L.A.: Fuzzy sets. *Inform. Control* **8**, 338–353 (1965)
- Zhou, J., George, J.M.: When job dissatisfaction leads to creativity: encouraging the expression of voice. *Acad. Manag. J.* **44**, 682–696 (2001)
- Zhou, J., George, J.M.: Awakening employee creativity: the role of leader emotional intelligence. *Leadersh. Q.* **1**(4), 545–568 (2003)
- Zhou, J.: When the presence of creative coworkers is related to creativity: role of supervisor close monitoring, developmental feedback, and creative personality. *J. Appl. Psychol.* **88**, 413–422 (2003)