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Emic Interest-Based Classification and Interest Model of College Majors in Taiwan*

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Indigenous interest-based classifications and interest models of college majors are essential for both the career exploration of students and higher education policymaking. In Taiwan, Holland's Codes are frequently used to determine college majors based on interest. However, Holland's Codes were developed in the United States and only later adopted in Taiwan. Therefore, this study developed an emic interest-based classification and an interest model of college majors by analyzing the preference ratings of 1,306 high school students for 166 college majors in Taiwan. A complete-linkage cluster analysis was used to construct a three-level hierarchical classification with 166 college majors, 26 major groups, and 7 major fields. Multidimensional scaling of the 26 major groups was used to create a spatial interest model consisting of three dimensions: content (object–mentality), characteristics (dynamics–structure), and function (communication–discovery). Convergence and divergence were observed between the results of the Holland Codes and the two commonly used content-based classifications of Taiwanese college majors.

Keywords: college majors, emic, interest model, interest-based classification

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Higher education is important to a nation (Hsieh, 2021; Wu, 2012) and the choice of a college major is crucial for students (Chang & Yu, 2021). The government needs classifications to organize college majors into comprehensive entities for decisions of educational policies. The classifications assist students' exploration and decisions of college majors. An interest model organizes both classifications and individuals' interests of the majors to serve the purposes of career exploration, policy making and research. These are particularly important now since Taiwan government is implementing new educational policies from Curriculum Guidelines of 12-Year Basic Education: General Guideline (2014) that emphasize students' autonomy of planning and choosing educational programs. This autonomy poses a big challenge for students to explore and make their higher educational decisions (Chang et al., 2016; Cheng et al., 2014). Proper classifications and interest models of college majors are needed not only for students to accomplish this challenging task, but also for education policy makers, researchers, and educators who are to facilitate students' educational planning.

Classifications can be made based on college majors' content or individual's attributes. An interest-based classification is a common type of attribute-based classifications and it can be foundation for the development of interest models. Career interests reflect culture and the career options, so interest models and interest-based classifications should be both culturally and contently sensitive. In Taiwan, Holland types are commonly used to organize college majors and students' interests for college majors (e.g., Ou & Chen, 2001). This etic application is neither cultural nor content, since Holland model was developed from US occupations instead of Taiwan's college majors. This research employs an emic approach to develop a classification and an interest model of Taiwan's college majors. The study connects this interest-based classification to the frequently used content-based classifications in Taiwan. This interest model is also compared to Holland's model.

Two Approaches to Classification Systems

Classification systems organize an expansive body of information and make information assessable to a various range of audiences (Gore et al., 2013). The audiences of college-major classifications include educational policy makers, researchers, students, and people who assist students with their educational decisions. Classifications can be made by two approaches: Content-based and attribute-based. A content-based approach classifies career options according to their characteristics. This type of classification is usually constructed by experts' judgment. The United Nations Educational, Scientific and Cultural Organization (UNESCO) used this approach to develop the International Standard Classification of Education: Fields of Education and Training 2013 (ISCED-F 2013; UNESCO Institute for Statistics, 2015). An attribute-based approach is based on individual's career attributes. It can be either from an existing theory or empirical data. Career interest is an attribute often used to construct this kind of classification (i.e., interest-based classification). Holland's model (Holland, 1959) is commonly used to construct interest-based classifications. Holland-type classifications can be made by three methods: incumbent, judge, and empirical (Rounds et al., 1999). The Holland codes of the occupations at the Strong Interest Inventory are by the incumbent method. They are from Holland interest profiles of people working at the occupations (Donnay et al., 2005; Harmon et al., 1994). Rounds et al. (1999) adopted the judge method and had the trained judges to rate the Holland interest profiles of the occupations at the Occupational Information Network (O*NET). The empirical method uses statistic techniques to assign Holland's codes to the career options. For example, Gottfredson et al. (1982) used discriminate function analysis techniques on occupational data to develop the Holland codes for the occupations of Dictionary of Holland Occupational Codes.

Empirical data of individuals' preferences toward career options can be used to construct an interest-based classification. It is exploratory and can be the start of an interest model. For example, Holland (1959) developed his interest model by reviewing the Strong Interest Inventory scoring keys. He solidified his topology through studies using Vocational Preference Inventory (VPI), which asked participants to rate their preferences toward occupational titles (Holland, 1958).

There are two approaches to make classifications of career options, but there has had no effort to examine the convergence and divergence between them. It is beneficial to make the comparison, because the convergence make crosswalks between them and the divergence provide complementary suggestions for each other.

Current Classifications of Taiwan's College Majors

Taiwan government uses a content-based classification, the Standard Classification of Study Subjects (SCSS), to collect and organize data of college majors. SCSS was first developed in 1968. To compare internationally and utilize international data, the 2007 SCSS (the fourth revision) adopted the structure of the 1997 ISCED. It has the fifth revision (Minister of Education Department of Statistics, 2017) to connect to the ISCED's latest revision (i.e., ISCED-F 2013) and to reflect domestic trends of education and economy in Taiwan.

Most Taiwan high school students take the College Entry Examination Center Interest Inventory (CEECII; Jin et al., 1993) to explore their career interests. To facilitate its interpretation, the CEECII team developed a content-based classification and an interest-based classification. The 18 Major Groups (18MG) is the content-based classification. The interest-based classification adopted an incumbent method to assign the Holland codes of college majors (Ou & Chen, 2001). Students have their SCSS scores of Holland types and use the interest-based classification to locate the majors that match their results. They can also explore 18MG's major groups that match to their interest profiles.

SCSS contains data collected by the government. 18MG has collective descriptions of majors as well as introductions and guides to specific majors. Taiwan high school students frequently use these classifications to explore their college majors. However, it has not had effort to examine how these classifications coincide with the groupings according to the students' interests.

Development and Use of Hierarchical and Spatial Interest Model

An interest model classifies and organizes career interests. It can be derived from an interest-based classification derived from surveying and analyzing individuals' preferences of the career options. For example, Holland model was developed from individuals' interests of occupations (Holland, 1959). A model does not only classify interests but also provides organizations of the interests to indicate the relationship among them. The organizations can be either hierarchical or spatial. A hierarchical model is unidirectional, while a spatial model is multidirectional.

In a hierarchical model, the interests sharing a characteristic are grouped together. The Strong Interest Inventory employs a three-level hierarchical structure to organize its test results: general interests, basic interests and occupational interests. The levels of hierarchy represent the specificity of the occupational interests. The degree of interest specificity required depends on the context (Tracey & Rounds, 1995). Individuals who are seeking a board understanding of vocational interest need general interests. For those who are deciding between several options, specific interests, such as occupational interests, may be needed.

Holland's model is spatial for its six interest types are located at a two-dimensional hexagon with the distances indicating the similarities among them. Prediger (1976) used People-Things and Data-Ideas as the two dimensions underlying Holland's interest hexagon. Individuals can identify preferences at these two dimensions and explore the vocational options nearby. Three-dimensional models of vocational interest have been proposed (e.g., Armstrong et al., 2004; Tracey & Rounds, 1996). Compared to a two-dimensional model, a three-dimensional model provides an additional dimension for career exploration.

Presentational differences of a model permit different interest profiles interpretations. The presentation of a model reveals the similarity among the coexisting interests within a person or a career option (e.g., a college major). The spatial model has its similarity index calculated by the distance among the co-existing interests, while the hierarchical model's is by whether the co-existing interests are within the same clusters. Holland referred the similarity as consistency and he suggested that consistency is related to a person's career persistency and achievement. Tracey et al. (2014) found consistency is related to occupational stability and career satisfaction.

The two presentations of an interest model enable various ways of career exploration and interest profile interpretations. An interest model with both presentations will not only allow both various ways of career exploration, but also permit direct comparisons between the two presentations.

Why Needs an Emic Interest-Based Classification and Interest Model

Holland's topology has been the dominant model to construct interest-based classifications of college majors in Taiwan. However, vocational preference is the product of the interaction between an individual's cultural heredity and personal forces (Holland, 1959). There is yet no proof that Holland typology reflects the whole picture of Taiwanese students' interests of majors. Deng et al. (2007) found that Holland typology is incomplete even for the current US world of work. They also demonstrated that the results supporting Holland's typology were due to the selection of research items matching the six types. This is often true for the studies supporting Holland' types in Taiwan because the data were often from measurements of selected items that matched typical Holland types (e.g., Jin, 1986; Ou et al., 2012). Their results merely support the existence of Holland six types but do not provide evidence to support that Holland six types fully represent Taiwanese's vocational interests.

To address the issue of etic application for the countries outside US, there are attempts from non-US countries to develop emic vocational models by analyzing participants' preference ratings of career option items (e.g., occupation titles, majors, and activities) relevant to their own countries (Einarsdóttir et al., 2013; Primavera et al., 2010). There has not been any effort of this kind in Taiwan.

Contently, Holland typology is developed from individuals' interests of occupations (Holland, 1958, 1959) instead of college majors. Though there may be similarities between college majors and occupations, college majors can relate to occupations of different Holland types. For example, according to the crosswalk between college majors and occupations in Taiwan (Wang & Liu, 2012), the major of Psychology relates to 30 occupations, including Investigative occupations (e.g., neuropsychologists), Enterprising occupations (e.g., human resource manager) and Social occupations (e.g., counseling psychologist). Also, occupations are not the sole factor considered by students for their decisions of college majors (Robst, 2007). There may be problems to use interest types derived from occupations to help students to explore their decisions for college majors. For example, it can be difficult to determinate students' preference toward Psychology major with their Holland code since Psychology can be related to many Holland codes. Therefore, it is needed to develop an emic interest model in Taiwan for both cultural and content reasons.

The Present Study

This study is to develop an emic interest-based classification and an interest model of Taiwan's college majors by analyzing high school students' preferences toward to the existing college majors in Taiwan. It also aims to examine the connections of this emic interest-based classification system to the two commonly used content-based classification systems in Taiwan (i.e., SCSS and 18MG), and the relations of this emic interest model to Holland's model. The research questions are:

1. What is the interest-based classification of Taiwan's college majors?
2. What are the connections of this classification to SCSS and 18MG?

3. What is the interest model of Taiwan's college majors?
4. What are the relations of this model to Holland's model?

Method

Participants

An interest-based classification is to arrange the career options consistent with the users' organization of interests so that they can navigate the possible options similar to their mindset accordingly. In Taiwan, high school students are frequent users of college majors' classification because most of them need to make a decision before entering colleges. Therefore, this study chose to concentrate on high school students' preferences toward college majors instead of college students'. Furthermore, college students can have more realistic understanding of their own majors than high school students, but their perceptions of other majors might be as imaginary as the high school students'. The classification and model reflects interests toward all the majors instead of the one particular to the individual, so the familiarity difference of one major might not decide the quality of preference rating data.

To ensure familiarity with the college majors, the participants were at their final year of senior high school (i.e., the third-year students) and after they had received the scores of General Scholastic Ability Test. This is when the students are most knowledgeable of majors since they have to survey college majors for submitting their college applications. Their perceptions of college majors have also been proved to be consistent with those of guidance counselors and college students (Liao, 2018).

This study has 1306 participants from 10 schools (four at southern Taiwan, four at central Taiwan, and three at northern Taiwan), and 594 (45.48%) participants are from the south, 488 (37.37%) from the central schools, and 224 (17.15%) from the north. It includes 719 females (55.05%), 582 males (44.56%), and 5 (0.38%) either did not report their gender or indentified their gender as other. There are 622 (47.63%) participants at the social science study track (ST), 673 (51.53%) at the natural science track (NT), and 11 (0.84%) did not prove this information.

Measurement

To represent Taiwan's college majors, the college major titles from the 2017 SCSS are used. The 2017 SCSS is a four-level classification system: 11 board fields (BFs), 27 narrow fields (NFs), 93 detailed fields (DFs) and 174 sub-detailed fields (SDFs). Only 152 SDFs have college majors (14 SDFs without college majors and 8 with only graduate programs). A major was selected from each SDF to construct the study instrument. The three education-related SDFs are not homogenous. For example, both Mathematics Education and Social Education are in SDF's Teacher Education for General Subject Area. Therefore, 13 education-related majors were selected from the three education-related SDFs. Furthermore, four SDFs have two majors selected from them: Language & Creative Writing and Applied Foreign Language from SDF's Other Language & Literature, Drama and Dance from SDF's Performing Arts, Chemistry and Applied Chemistry from SDF's Chemistry, and Anthropology and Ethnology from SDF's Anthropology & Ethnology. Therefore, the research measurement has 166 items. The chosen college majors are either of the same names as their SDFs or representative of the SDFs. For example, History is chosen for the SDF's History. Social & Regional Development represents the SDF's Area Studies. There are 91 college majors (i.e., 56%) sharing the same names with their SDFs.

The instruction which asked the participants to only consider their preferences (not whether they could get admission) to 166 college majors on a 7-point scale with the anchors of 1 labeled as "*strongly dislike*," 2 as "*dislike*." 3 as "*somewhat dislike*," 4 as "*indifferent*," 5 as "*somewhat like*," 6 as "*like*," and 7 as "*strongly like*." An item example is 數學系 (i.e., Mathematics).

Data Collection and Ethic Considerations

The measurements were distributed by the guidance counselors. In Taiwan, they are the main force to assist students choosing a college major. In addition to provide research data, the measurement was proposed to the guidance counselors as another resource to extend the students' knowledge of existing college majors in Taiwan. The guidance counselors were provided a brochure containing a brief introduction for each major, so that they can explain the majors to the students when they need further information. The guidance counselors distributing the measurement agreed that completing the measurement benefits their students' career exploration. The students were told that they were free not to complete the measurement and turn in their surveys blank. The surveys were collected in piles so that the collectors would not know any participant's completion status. There are 143 blank surveys which account for 10% of the surveys distributed. The study results contain no identifiable personal information. To further protect the participants' privacy, the demographic information was at a separate page from the pages with the ratings of college majors, and the demographic page was kept separately from the ratings pages in a locked room.

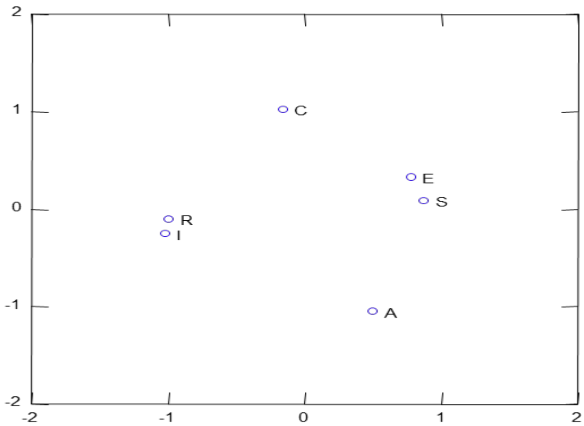
Assigning Holland Code to College Majors

To assist data analyses, the judge method was employed to assign Holland ratings to the majors. The author and two guidance counselors served as the judges. These two guidance-counselor raters have been using the Holland model to help their students' exploration of higher education decisions for years. Hence, they are familiar with the descriptions of the six Holland types and the content of college majors. To assist the rating, the judges also referenced the official websites of the college majors.

Based on how characteristic a major is to each Holland type, the judges provided a rating for the major on a 7-point scale with 1 labeled as "very not characteristic," 2 as "not characteristic," 3 as "somewhat not characteristic," 4 as "moderately characteristic," 5 as "somewhat characteristic," 6 as "characteristic" and 7 as "very characteristic." The inter-rater reliability indexes are Pearson correlation coefficients between the judges' ratings. The 18 correlations (i.e., six Holland types and three raters) range from .61 to .84 (M = .71, SD = .07), indicating good inter-rater consistency. MDS configuration for the judge ratings (Figure 1) confirms Holland's circular arrangement (i.e., RIASEC), hence the construct validity is supported.

Figure 1

Two-Dimensional Holland Model of Judge Ratings for the College Majors



Note. This configuration was from a multidimensional scaling on the judge-rating Holland profiles of collage majors (Stress = .021, VAF = .997). R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

Quality of Measurement Data

To examine the quality of high school students' responses of college majors, their preference ratings of college majors were used to construct another set of Holland profiles for the majors. This set of Holland profiles were correlated to the judges'. The CEEII Holland scores of 805 participants were collected. The correlations between the students' preference ratings of a major and their CEEII Holland scores are the Holland profile of this major. For example, the correlations between the preference ratings of Visual Arts and the CEEII Holland scores are .03 (R), .02 (I), .50 (A), .10 (S), .03 (E), -.13 (C). Thus, Visual Arts has a Holland profile of (.03, .02, 50, .10, .03, -.13). The multivariable-multimethod convergence (Table 1) between the two sets of Holland profiles supports the quality of the measurement data.

Table 1
Correlations Between Holland Profiles of Participants' and Judges' Ratings

Judges' Ratings	Students' Preference Ratings					
	R	I	A	S	E	C
R	.77**	.65**	-.41**	-.63**	-.58**	-.18*
I	.58**	.73**	-.51**	-.57**	-.54**	-.06
A	-.49**	-.49**	.80**	.44**	.14	-.61**
S	-.61**	-.58**	.31**	.69**	.47**	.17*
E	-.54**	-.61**	.21*	.44**	.86**	.50**
C	.01	.03	-.50**	-.11	.29**	.81**

Note. Numbers in bold indicate the correlations between the same types.
* $p < .05$. ** $p < .01$.

Data Analysis

The complete-linkage clustering is to classify the college majors into groups. The complete-linkage clustering is one of the several hierarchical clustering methods. It tends to find compact clusters (Defays, 1977) because it lets the pair-wise distance (i.e., *d*) between all elements in a cluster be no greater than the cluster's joint distance. The distance is calculated by 1 minus Pearson correlation coefficient *r* between the two elements. For example, the cluster of Protective (see Figure 2) is joined at $d = .69$, it means that the farthest distance of all pairs between the elements of this cluster is .69. That is, *r* of each pair between the elements within the cluster is larger or equal to .31. The multidimensional scaling (MDS) result of the college major groups is to form the interest model. MDS techniques are to translate the pair-wise distances among objects into a spatial configuration (Mead, 1992).

Results

Taiwan's Interest-based Classification of College Majors (TICM)

TICM is derived from two complete-linkage cluster analyses. The first complete-linkage cluster analysis was on the participant's preference ratings of the 166 majors. Twenty-six clusters were resulted at $d =$ .67. The minimum *r*s of these 26 clusters range from .33 to .79 ($M = .48$, $SD = .11$). These 26 clusters are referred as Taiwan major groups (TMGs). Another complete-linkage cluster analysis grouped the 26 TMGs into seven clusters at $d = .69$. These clusters are referred to Taiwan major fields (TMFs). Their minimum rs range from .31 to .51 ($M = .40$, $SD = .08$).

The dendrogram of the 166 majors to the 26 TMGs is too tedious to present, so their relations are shown at Table 2 instead. Figure 2 presents the TMFs and their TMGs. The seven TMFs are Protective, Outdoor, Factual, Managerial, Human, Aesthetic, and Social.

Protective

Protective includes studies of human, animals, plants and environmental resources in order to protect or enhance their development. It has five TMGs: Environment, Agriculture, Biomedicine, Healthcare, and Justice. Environment's majors study environment (e.g., Earth Sciences) and to promote environmental conservation (e.g., Soil & Water Conservation). Agriculture's majors are to enhance the cultivation (e.g., Plant Medicine) and sales (e.g., Agricultural Extension) of plants and livestock. Biomedicine's majors are biology (e.g., Biology) and medical practices (e.g., Medicine and Veterinary Medicine). Healthcare's majors are health aids (e.g., Occupational Therapy) and food sciences (e.g., Nutrition). Justice has the majors that preserve the safety of general public (e.g., Criminology).

Outdoor

Outdoor involves planning and implementing outdoor activities or buildings. Its three TMGs are Sports, Transportation, and Building. Sports has the majors related to physical activities (e.g., Sports & Leisure). Transportation includes the majors of public transportations (e.g., Transportation Management). The majors of Building plan and make building projects (e.g., Urban Planning).

Factual

Factual studies and operates factual laws of materials, numbers and codes. It has three TMGs: Materials, Number, and Computer. The majors of Materials study the phenomena and applications of physics (e.g., Electronics Engineering) and chemistry (e.g., Chemical Engineering). Computer includes all the computer-related majors (e.g., Information Software). Number's majors deal with numbers (e.g., Mathematics).

Managerial

Managerial includes studies of managing money, sales, or people. It has three TMGs. Business's majors are to promote sales benefits (e.g., International Trade), and Politics' majors study how to govern and influence people (e.g., Political Sciences). Finance's majors analyze money and its trend (e.g, Economics).

Human

Human includes studies of human civilization. Its two TMGs are Civilization and Human Development. Civilization addresses the past events (i.e., History) and humanistic space arrangement (i.e., Geography). Human Development examines the evolution of human being (e.g., Anthropology) and ideas (e.g., Philosophy).

Aesthetic

Aesthetic has the majors of arts making in various forms. Its three TMGs are Performance Arts, Visual Arts, and Shaping Arts. Performance Arts' majors execute arts in front of an audience either live or recorded (e.g., Music). Visual Arts includes the majors of graphs (e.g., Fine Arts) and designs (e.g., Visual Design). Shaping Arts has the majors that crave or weave aesthetic pieces (e.g., Sculpture).

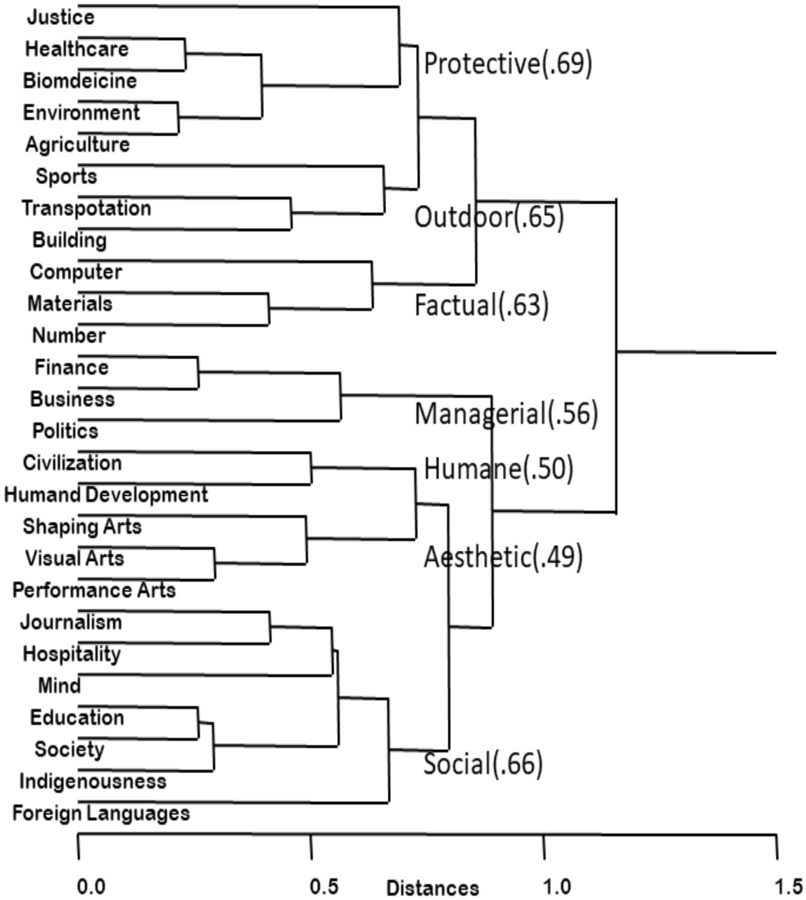
Social

Social is to study society or to provide services to people. It has seven TMGs: Mind, Education, Society, Hospitality, Indigenousness, Foreign Languages, and Journalism. Mind's majors are psychology-related (e.g., Psychology). Education has the majors assisting special populations (e.g., Adult & Continuing Education) and the majors studying educational equipments or policies (e.g., Education Administration & Policies). The majors of teaching specific subjects belong to the major groups of the subjects. For example, Mathematics Education is in TMG's Number. Society's majors study society and provide services to the public (e.g., Social Work). Hospitality's majors cater services to individuals' leisure (e.g., Tourism & Leisure) or beauty needs (e.g., Cosmetic Science). Indigenousness' majors are domestic language (e.g., Chinese Studies), literatures (e.g., Taiwanese Literature), arts (e.g., Indigenous Arts) and society (e.g., Ethnology). Foreign Languages studies languages and literatures other than Chinese (e.g., English Literature). Journalism's majors produce communication and distribution of information through media (e.g., Mass Communication).

To examine TICM's appropriation for the students of the two study tracks, the minimal rs of the TMGs and TMFs are computed. All the minimal rs are larger than .24 and most are larger than .30 (Table 2). For those minimal rs less than .30, their Cronbach αs are calculated to examine their internal consistency. All αs are larger than .70 expect Factual's .64 which is still acceptable. This indicates that TICM is proper for students of both the study tracks.

Figure 2

Taiwan Major Fields (TMF) and Their Taiwan Major Groups (TMG)



Note. The distance of each TMF's final joint is in the bracket.

Table 2
Three Levels of Taiwan's Interest-Based Classification of College Majors (TICM)

TMF	TMG	Major
Protective	Justice (.47, .50, .48)	Police Administration, Criminology
(.31, .26 [.73], .39)	Healthcare (.39, .40, .38)	Nursing, Public Health, Occupation Safety & Health, Health Education, Nutrition, Food Science, Speech Pathology & Audiology, Occupational Therapy, Physical Therapy, Pharmacy, Chinese Medicine, Clinical Laboratory Sciences, Health Care Administration
	Biomedicine (.40, .34, .32)	Veterinary Medicine, Dentistry, Bio-informatics, Biology, Biomedical Engineering, Biomedical Sciences, Medicine, Microbiology, Ecology, Biotechnology
	Environment (.33, .35, .28 [.96])	Civil Engineering, Earth Sciences, Oceanography, Environmental Planning & Disaster Management, Refrigerating Air-Conditioning Engineering, Navigation, Surveying Engineering, Atmospheric Sciences, Environmental Engineering, Bio-Agricultural Sciences, Applied Life Science, Environmental Resources, Agricultural Chemistry, Soil & Water Conservation, Harbor & River Engineering, Environmental & Cultural Resources, Industrial Management & Enterprise Information, Mining & Petroleum Engineering, Fisheries Production & Management
	Agriculture (.48, .47, .48)	Aquaculture, Animal Science, Agricultural Extension, Forest Products Science, Plant Medicine, Horticultural Science, Agronomy
Outdoor	Sports (.63, .57, .70)	Physical Education, Sports & Leisure, Exercise & Health Sciences, Athletic Sports
(.35, .33,.35)	Transportation (.51, .47, .57)	Aviation Services & Management, Transportation Management, Shipping & Transportation Management
	Building (.48, .38, .57)	Urban Planning, Construction Management, Architecture
Factual	Computer (.61, .60, .62)	Information Software, Information Networking Technology, Information Technology, Information Management
(.37, .25 (.64), .41)	Materials (.43, .34, .29 [.96])	Industrial Engineering, Physics, Chemistry, Science Education, Industrial Technology Education, Nuclear Science, Chemical Engineering, Electronics Engineering, Mechanical Engineering, Applied Chemistry, Engineering Science, Materials Engineering, Computer Application Engineering, Energy Engineering, Vehicle Engineering, Aeronautics & Astronautics, Naval Architecture & Ocean Engineering

(continued)

Table 2
Three Levels of Taiwan's Interest-Based Classification of College Majors (TICM)(continued)

	Number (.79, .80, .74)	Mathematics Education, Mathematics
Managerial	Finance (.42, .43, .43)	Statistics, Financial Law, Public Finance, Finance, Accounting, Economics
(.44, .31, .50)	Business (.47, .38, .45)	Business Management, Marketing & Distribution Management, Service Business Management, Risk Management & Insurance, Business, International Trade, Business Education
	Politics (.60, .54, .58)	Law, Government & Law, Political Science
Humane	Civilization (.42, .38, .43)	History, Geography
(.50, .50, .51)	Human Development (.37, .36, .37)	Religion Studies, Philosophy, Anthropology
Aesthetic	Shaping Arts (.50, .46, .55)	Sculpture, Textile Engineering
(.51, .51, .52)	Visual Arts (.52, .53, .51)	Arts, Applied Arts, Fine Arts, Fashion Stylist Design, Arts & Crafts, Fashion Design, Spatial Design, Visual Design, Visual Art, Advertising, Landscape Architecture, Product Design, Arts Education, Textiles & Clothing
	Performance Arts (.47, .42, .51)	Music, Dance, Drama & Theatre
Social	Journalism (.52, .45, .48)	Mass Communication, Graphic Arts & Communication, Journalism, Radio & Television
(.34, .24 [.82], .35)	Hospitality (.39)	Tourism & Leisure, Food & Beverage Management, Cosmetic Science
	Mind (.60, .60, .58)	Psychology, Guidance & Counseling
	Education (.38, .27 [.88], .42)	Child Care, Early Childhood Education, Educational Technology, Adult & Continuing Education, Senior Citizen Service Management, Home Economics Education, Educational Administration & Policies, Education, Special Education
	Society (.37, .28 [.92], .40)	Public Administration, Cultural Industries, Public Relationship & Design, Sociology, International & Mainland China Affairs, Social Work, Social Education, Humanities & Social Sciences, Human Resource Management, Social & Regional Development, Education & Human Potential Development
	Indigenousness (.39, .30, .42)	Chinese Language Education, Ethnology, Taiwanese Literature, Chinese Language & Literature, Indigenous Arts, Library, Language & Creative Writing, Teaching Chinese as a Second Language, Chinese Studies
	Foreign Languages (.62, .55, .62)	Translation & Interpreting, Foreign Language Instruction, Foreign Languages & Literatures, Applied Foreign Languages

Note. Numbers next to TMG or TMF the minimum rs for each pair of its cluster elements from all participants (AP), the social track participants (ST), and the natural track participants (NT) respectively. For example, Social's minimum rs from AP, ST, and NT are .34, .24, and .35. For TMG or TMF with a minimal r less than .30, its Cronbach α is in the bracket next to the r. For example, Social has a minimal r of .24 from ST and its Cronbach α is .92.

Interest-based Classification and Content-based Classification

TICM's connections to18MG and SCSS are addressed by the match rates of each TMG in a NF or a MG. The match rate is the percentage of the TMG's majors from a NF or a MG. The main match is the NF or the MG with the highest match rate. For example, three of Finance's six majors are from NF's Business & Administration, thus, the NF match rate is 50% (see Table 3). Business & Administration also has the highest match rate. Therefore, Business & Administration is the NF main match of Finance. When multiple NFs with the highest match rate, the main match is the NF capturing the characteristics of the TMG. For example, Numbers has a 50% match rate to both NF's Mathematics & Statistics and Education. Mathematics & Statistics is chosen to be the NF main match because the two majors are both related to mathematics. However, Visual Arts has two MG main matches because Arts and Architecture & Design both capture the characteristics of this TMG's visual aesthetical presentation.

TICM's Convergence to SCSS and 18MG

The main match rates between TMGs and 18MG's MGs ranges from 50% to 100% (M = 82% and SD = 19%). The main match rates between TMGs and SCSS's NFs range from 16% to 100% (M = 69% and SD = 24%). There are 12 TMGs (out of 26 TMGs) with a MG perfect match (i.e., all their majors from the same MGs) and seven TMGs with a NF perfect match. Though two TMGs (i.e., Environment and Society) have their NF main-match rate less than 50%, their majors are still closely related. Society's majors are studies of social phenomena (e.g., Sociology), services (e.g., Social Work), or operation (e.g., Public Administration). Environment's majors are studies of environmental phenomena (e.g., Oceanography) or resources (e.g., Environmental Resources). These results indicate a good fit between TICM and 18MG, and between TICM and SCSS.

MG and NF Main-Matched to Multiple TMGs

There are six NFs and six MGs main-matched to multiple TMGs. For those with multiple main-matches to the same TMF, TICM separates them into finer content-homogenous groups. For example, the majors of NF's Business & Administration belong mainly to two Managerial's TMGs that differ from each other by the objects they manage. The majors managing sales and people are in Business, while the majors managing money trends are in Finance. Those multiply main-matched to different TMFs suggest TICM's divergence to 18MG or SCSS. For example, the multiple main matches of 18MG's Architecture & Design propose a suggestion to divide this MG into two groups: Architecture and Design.

NF Main-Matched to No TMG

The six NFs main-matched to no TMG are Manufacturing & Processing, Veterinary Medicine, Hygiene & Occupational Health Services, Forestry, Fisheries, and Social Welfare. They all have no more than three SDFs and their majors are merged to TMGs that capture their characteristics. The majors of Forestry & Fisheries are in Agriculture. Social Welfare's majors are in Society. The majors of Hygiene & Occupational Health Services are in Healthcare. Veterinary Medicine has only one major and it is merged to Biomedicine. The three majors of Manufacturing & Processing are merged to three different TMGs: Textiles & Clothes to Visual Arts, Mining & Petroleum Engineering to Environment, and Food Sciences to Healthcare

Taiwan's Interest Model of College Majors (TIMM)

A three-dimensional model was from a MDS result of the 26 TMGs (stress = .11, VAF = .90). The Holland profiles of majors from the judge ratings were used to assist the interpretation of TIMM's dimensions. The Holland profile of each TMG is the mean Holland profile of its majors. For example, the majors of Mind are Psychology and Guidance & Counseling. Psychology's Holland profile of (R, I, A, S, E, C) is (2.67, 6.33, 4.67, 6.00, 3.67, 2.67) and Guidance & Counseling's is (1.67, 4.67, 4.67, 7.00, 4.33, 3.00). Thus, Mind's Holland profile is (2.17, 5.50, 4.67, 6.50, 4.00, 2.83).

To find the orthogonal factors underlying Holland's six types, a principal component analysis was performed for the Holland profiles of the 26 TMGs. The eingenvalues of the first four factors are 2.32, 1.73, 0.99 and 0.52, so three factors were chosen. To obtain simple and interpretable factors that are orthogonal to each other (Yaremko et al., 1986), a varimax rotation was used and three Holland factors were resulted. They are C-A, S-R, and E-I (Table 4) and their VAFs are 29.5%, 28.12%, and 26.5% respectively.

Table 3
Matches of Narrow Field (NF) and Major Group (MG) to Taiwan Major Group (TMG)

TMG	Match Target	
	NF	MG
Environment (P)	Environment (16%)	Earth & Environment (53%)
Agriculture (P)	Agriculture (71%)	Biological Resources (100%)
Healthcare (P)	Medicine & Health (62%)	Medicine & Hygiene (92%)
Biomedicine (P)	Life Sciences (50%)	Life Sciences (70%)
Justice (P)	Security Services (50%)	Law & Politics (100%)
Politics (M)	Law (67%)	Law & Politics (100%)
Finance (M)	Business & Administration (50%)	Finance (67%)
Business (M)	Business & Administration (71%)	Management (86%)
Transportation (O)	Transport Services (100%)	Management (100%)
Building (O)	Architecture & Construction (100%)	Architecture & Design (100%)
Sports (O)	Hospitality, Tourism & Personal Service (75%)	Sports & Recreation (100%)
Hospitality (S)	Hospitality, Tourism & Personal Service (100%)	Sports & Recreation (67%)
Performance Arts (A)	Arts (100%)	Arts (100%)
Shaping Arts (A)	Arts (50%)	Arts (50%)
Visual Arts (A)	Arts (71%)	Arts (50%), Architecture & Design (50%)
Mind (S)	Social & Behavioral Sciences (50%)	Society & Psychology (100%)
Society (S)	Social & Behavioral Sciences (27%)	Society &Psychology (55%)
Journalism (S)	Journalism & Library Information (100%)	Mass Communication (100%)
Education (S)	Education (78%)	Education (89%)
Foreign Languages (S)	Languages & Literatures (75%)	Foreign Languages (100%)
Indigenousness (S)	Languages & Literatures (56%)	Literatures, History & Philosophy (78%)
Human Development (H)	Humanities (100%)	Literature, History & Philosophy (67%)
Civilization (H)	Humanities (50%)	Literature, History & Philosophy (50%)
Number (F)	Mathematics & Statistics (50%)	Math & Physic & Chemistry (100%)
Computer (F)	Information & Communication Technologies (100%)	Information (100%)
Materials (F)	Engineering & Engineering Trades (65%)	Engineering (76%)

Note. Letter next to TMG indicates its TMF where O = Outdoor, A = Aesthetic, S = Social, P = Protective, F = Factual, and M = Managerial. For example, Education (S) indicates that Education is in the TMF of Social. Number next to each main-match NF or MG is the percentage of its majors in the TMG. For example, Law (67%) indicating 67% of TMG's Politics majors from NF's Law. NFs or MGs matched to multiple. TMGs are in bold.

Table 4

Component Loading of Principle Component Analysis on Judges' Holland Ratings

Holland Type	Component		
	C-A	S-R	E-I
Conventional	.93	.11	.09
Artistic	-.86	.31	.14
Realistic	.08	-.93	-.02
Social	-.04	.77	.33
Investigative	.25	-.05	-.90
Enterprising	.30	.32	.80

Note. The contrasting loadings of a dimension are in bold. For example, at C-A Dimension, the loadings of Conventional and Artistic are .93 and -.86 respectively.

Property vector fitting (PVF; Kruskal & Wish, 1978) examines the inclusion and location of Holland factors in TIMM. PVF is to perform a multiple regression of the three MDS dimensions onto each of three Holland factors (Table 5). A VAF larger than .50 indicates the inclusion of a factor in the model. The betas are the coordinates of Holland factors in the MDS configuration. For example, the vector of the S-R is (.57, -.43, .31). All three Holland factors have VAF larger than .50, indicating their existence in the model. Furthermore, the three Holland factors are orthogonal to each other, so they can be the dimensions of the MDS configuration through mathematical rotations of the three original MDS dimensions. For the rotations, the angles between the MDS dimensions and Holland factors are calculated by the law of cosine. For example, the vector of S-R is (.57, -.43, .31) and the Dimension 1 is (1, 0, 0), so S-R Dimension is Dimension 1 rotated 42.85. By the same algorithm, C-A Dimension is Dimension 2 rotated 149.41 and E-I Dimension is Dimension 3 rotated 143.15.

To examine the existence of TIMM's three dimensions for the students of both study tracks, PVF is again employed for the MDS results from the data of the ST participants and the NT participants. The three-dimensional MDS for the ST participants has stress = .12 and VAF = .89, while the three-dimensional MDS of the NT participants has stress = .14 and VAF = .86. All the VAFs of TIMM's three dimensions are larger than .50 (See Table 5), indicating the three dimensions existing in the two MDS results and they apply to the students of both study tracks.

Table 5

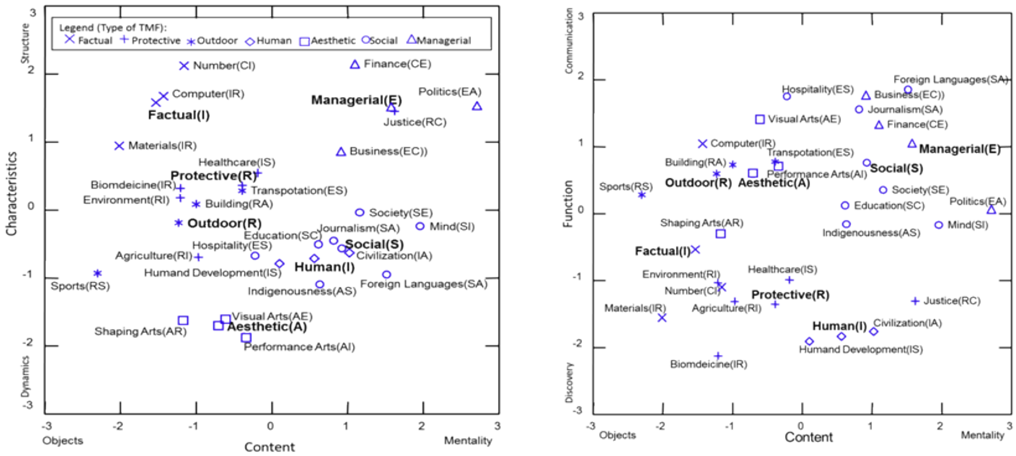
Property Vector Fitting of MDS Results onto TIMM's Dimensions

Participants	Dimension	Content (S-R)		Characteristics (C-A)		Function (E-I)	
		B	R^2	*B*	R^2	*B*	R^2
All	Dimension 1	.57**	.60**	-.44**	.76**	.44**	.64**
	Dimension 2	-.43*		-.75**		-.19	
	Dimension 3	.31*		.04		-.64**	
Nature Track	Dimension 1	.47**	.58**	-.75**	.80**	.29	.56**
	Dimension 2	-.57**		-.33**		-.62**	
	Dimension 3	-.20		-.36**		-.30*	
Social Track	Dimension 1	-.37**	.97**	.76**	.95**	-.54**	.93**
	Dimension 2	-.90**		-.52**		-.19*	
	Dimension 3	.16**		-.32**		-.79**	

* $p < .05$. ** $p < .01$.

Figure 3

Taiwan's Interest Model of College Majors (TIMM)



Note. TIMM is the three-dimensional MDS configuration of 26 Taiwan Major Groups (TMG) with stress = .11 and VAF = .90. TMG is with a two-letter Holland code. Taiwan Major Field (TMF) is in bold and with one-letter Holland code.

Prediger (1976) named the S-R dimension as People-Things. However, the R-side TMGs do not study only things but also people (e.g., Biomedicine), so this dimension is named as Mentality-Object instead of People-Things. Mentality is to study human thoughts (e.g., Mind). Object is to study numbers (e.g., Number), materials (e.g., Material), and organisms (e.g., Biomedicine). TMGs involving both Object and Mentality are in the middle of this dimension (e.g., Healthcare). This dimension is also referred as Content for its indication of the subjects studied.

The dimension contrasting E and I was named as Persuasion-Problem Solving in the Strong Ring (Armstrong et al., 2004). However, the E-side TMGs are to use various medias to communicate. Languages (e.g., Foreign Languages), management (e.g., Business), codes (e.g., Computer), and artistic platforms (e.g., Visual Arts) are used to communicate for manufacturing relationships, behaviors or products. The I-side TMGs aim to discover information for knowing (i.e., Human Development) and problem solving (e.g., Biomedicine). Thus, this dimension is named as Communication-Discovery instead of Persuading-Problem Solving. The middle of this dimension has TMGs involving both Communication and Discovery (e.g., Education). It is also called Function for it suggests the functionality of TMGs.

TIMM adopts the Stong Ring's naming (Armstrong et al., 2004) to refer the C-A as Dynamic-Structure. Structure's TMGs emphasize rules and protocols (e.g., Finance), while Dynamics' TMGs focus on fluidity (e.g., Performance Arts). The TMGs at the middle require both protocols and fluidity (e.g., Environment). This dimension is also called Characteristics for its reference to the feature of the TMGs.

TIMM and Holland Model

To compare TIMM and Holland Model, Holland codes are assigned to TMGs and TMFs. TMFs and Holland's RIASEC are both general interests, so each TMF's Holland code is with one Holland type. TMGs are basic interests and there are 26 of them. A code of two Holland types has 36 possible combinations, so each TMG is assigned a code of two Holland types. TMG's Holland code is the first two Holland types with the highest scores in its Holland profile. For example, Agriculture's Holland profile has 6.14 (R), 5.14 (I), 2.67 (A), 2.19 (S), 2.86 (E), and 3.57 (C), so its Holland code is RI. TMF's Holland code is the majority of its TMGs' first Holland codes. For example, Managerial's TMGs have their first letters of Holland codes of

E (Business), E (Politics), and C (Finance), so Managerial's Holland code is E.

Social, Aesthetic, and Managerial correspond to Social, Artistic, and Enterprising of Holland respectively. There are two Investigative TMFs which are Factual (investigation of materials or number) and Humane (investigation of human). Holland's Realistic becomes Protective and Outdoor. No Conventional TMF was found. Conventional TMGs belong to different TMFs. When calculating numbers to produce scientific knowledge (i.e., Number), Conventional is in Factual. When using numbers to manage money (i.e., Finance), it is in Managerial. This suggests heterogeneity of Holland's types when applying to interests of Taiwan's college majors. The study results also suggest that Holland types can be located at three dimensions instead of two dimensions.

Discussion

This study constructs an emic interest-based classification (i.e., TICM) and interest model (i.e., TIMM) of Taiwan's college majors. They are compared to the two frequently used classifications (i.e., SCSS and 18MG) and Holland's model.

Emics of TICM and TIMM

Culturally, TICM reflects the study groups commonly used for Taiwanese college preparation. They are social sciences, STEM, biomedicine, arts, and sport. College Admissions Committee (2021) arranges all the college majors into eight study groups for its Star Admissions Project. The eight groups include social sciences, STEM, two biomedicine groups (biomedical sciences and medical/dental schools), three arts groups (music, graphic arts, and dance), and sports. Table 6 presents the correspondence between TMFs and the study groups.

TIMM dimensions contribute to understanding the study groups and their relationships (see Table 6). The dimensions identify the characteristics underlying the study groups. For example, the dimensions reveal that Aesthetical is dynamic, studies objects and serves to communicate. The dimensions also explain the differences between the study groups. For example, the dimension of Content contrasts the different study contents between the natural sciences (i.e., studying objects) and the social sciences (i.e., studying human mind). Furthermore, the dimensions also distinguish the study groups into finer comprehensive entities. For example, the social sciences group is divided into Social and Human by the dimension of Function, and into Managerial and Social by the dimension of Characteristics.

Table 6

Correspondence of Holland Types, TMFs and TIMM's Dimensions to Study Groups

TMF	TIMM's dimension			Study group
	Content	Characteristics	Function	
Outdoor	Object	Dynamics/Structure	Communication	Sports, STEM
Factual	Object	Structure	Discovery	STEM
Protective	Object/Mentality	Structure	Discovery	Biomedicine
Aesthetic	Object	Dynamics	Communication	Arts
Human	Mentality	Dynamics	Discovery	Social Sciences
Social	Mentality	Dynamics	Communication	Social Sciences
Managerial	Mentality	Structure	Communication	Social Sciences

Note. Protective is located in the middle of Content, so it has Object/Mentality. Outdoor is at the middle of Characteristics, so it has Dynamic/Structure.

Contently, the three dimensions derived from data of occupational interests are frequently referred as People-Things, Data-Ideas, and prestige (e.g., Deng et al., 2007; Tracey & Rounds, 1996). TIMM's Mentality-Object corresponds to People-Things and its Dynamics-Structure is similar to Data-Ideas. Meanwhile, its third dimension is functionality instead of prestige. Functionality can be found in the Strong Ring which was from data consisting interests of study subjects (Armstrong et al., 2004). This difference might not necessarily mean there is not a prestige dimension in high school students' interests of college majors, since there can be infinite numbers of dimensions in a spatial model and this study does not examine the existence of prestige in TIMM, It also needs further research efforts to clarify the existence of functionality in interests of occupations. However, this result does indicate the significance of functionality in interests of college majors.

TICM's Convergence and Divergence to 18MG and SCSS

This study reveals the relationship between content-based and attribute-based classifications. SCSS and 18MG are content-based classifications constructed from experts' judgment of content similarity among college majors. The experts' judgment is based on the information of majors. TICM is an attribute-based constructed by statistically calculating the similarity of high school students' interests toward the majors. The students' interest ratings are based on their impressions. The convergence indicates that contents and interests of college majors are organized similarly. The similar organizations provide crosswalks for TICM to 18MG and SCSS. The convergence also indicates the overlap between experts' information and students' impression of college majors. This indicates the third-year high school students have been able to distinguish the study fields and characteristics of college majors. This can be the result of their cognitive growth to comprehend and distinguish the fields of work (Gottfredson, 2005), and the deliberate joint efforts of the students and school staff to explore information for the forthcoming decisions of college majors.

There are still some divergence between TICM and the two content-based classifications. It provides suggestions to refine 18MG and SCSS to become more interest-homogeneous. For example, SCSS's Business & Administration can be divided into two groups: Business (management of sales and people) and Finance (management of money). The divergence also reveals the aspects of college majors that the students' impressions tend not to cover. For example, Textiles & Clothes, Mining & Petroleum Engineering, and Food Sciences are not in a TICM's TMG, but they are all in SCSS's NF of Manufacturing & Processing.

Correspondence Between TIMM and Holland Model

This study results support the use of Holland types for the interests of Taiwan's college majors, but Holland's types form three dimensions instead of two dimensions. A three-dimensional presentation of Holland's Types has also been revealed in the Strong Ring (Armstrong et al., 2004), which is derived data containing preference ratings of study subjects. This indicates the use of Holland's types as three orthogonal factors instead of just a two-dimensional hexagon as least for study subjects.

TMFs correspond to Holland's types, but suggest heterogeneity within Holland's types. Both Investigative and Realistic are divided into two groups. Conventional is supplementary to other general interests.

Conclusions

The structure of career options is cultural and contently. It serves the purposes of organizing career information and assisting career exploration. This study has constructed an interest-based classification and an interest model of Taiwan's college majors. The model is presented both hierarchically and spatially. It also connects to the commonly used classification systems and an interest model in Taiwan. These results have their practical and theoretical implications. Theoretical implications stimulate research ideas. Practical implications provide suggestions for high school students and those who assist them with choosing college majors, and for the policy makers of higher education in Taiwan.

Theoretical Implications

This is a starting attempt to construct an emic interest model of Taiwan's college majors, though TIMM may not be THE interest model. It has refined and extended two commonly used content-based classifications (i.e., 18MG and SCSS). It also suggests the applications of Holland's model to Taiwan's college majors. The connections of TIMM to the classifications and Holland's model allow comparative studies between classification systems and between career models.

The hierarchical and spatial presentations of TIMM allow different interpretations of consistency, an index to indicate the similarity of the interests within an interest profile (Holland, 1997). With the hierarchical presentation, the calculation of consistency is whether the interests are within the same categories. With the spatial presentation, the index of consistence is the geographical closeness of the interests. For example, in the hierarchical model, the interest profile of Visual Arts and Indigenousness is not considered consistent, since they are not from the same TMF. The profile may be considered consistent because they are close to each other at the spatial model. Holland (1997) also suggested that consistency is correlated to difficulty of decision-making. Higher consistency leads to easier decision-making. TIMM can provide two consistency indexes for this hypothesis testing.

Finally, this study suggests a three dimensional presentation of Holland's six types. The Strong Ring (Armstrong et al., 2004) has a similar result as well. It is noticeable that both TIMM and the Strong Ring both have preference ratings of study subjects. It needs further research efforts to know whether Holland's types can be located in a three-dimensional space by merely preference rating of occupations.

Practical Implications

TIMM provides an alternative model for high school students to explore the college majors that interest them. One of its advantages is its correspondence to the commonly referred study groups of college majors in Taiwan. An interest profile of TMFs and the three dimensions can reveal a student's interest of the study groups, so that the student can explore and choose courses or a college major accordingly. Another advantage is its connections to SCSS and 18MG. With their interests of TMGs and TMFs, students can access the information collected and organized by SCSS and 18MG.

TIMM's hierarchical and spatial features enable various ways of explorations. Career exploration is linear with a hierarchical presentation, while a spatial presentation allows regional exploration. For example, when a student is interested in Sports, with the hierarchical model, this student can explore either the majors within Sports or the TMGs in the same TMF (i.e., Outdoor), such as Transportation. Spatially, this student can explore the TMGs located nearby Sports, such as Agriculture. The dimensions of the spatial presentation can further assist exploration within a TMF. For example, the TMGs of Protective spread out across the dimension of Dynamics-Structure. A student who likes Protective and is with a high preference of Dynamics may be more interested in exploring Agriculture rather than Justice.

The study results show the convergence and divergence between an interest-based classification and two commonly used content-based classifications. These provide suggestions for the agencies responsible of collecting information of college majors to organize their data interest-homogeneously. Furthermore, the connections between SCSS and TICM create opportunities to understand the relations between students' interests and the current high education data that Taiwan government collects through SCSS, hence to make policy decisions accordingly.

Limitation and Future Directions

This study is neither a construction of interest measurement, nor empirical efficacy comparisons of TIMM to the frequently used Holland model, SSCS, and 18MG. This study results provide a foundation to construct measurements to assess interests for college majors. Future studies can compare the effectiveness of TIMM to SSCS, 18MG, or the Holland model when assisting or predicting high school students' decisions for a college major. Furthermore, it can be interesting to examine the fit of this model to college students' preferences toward majors to know how a career decision made affects the perception of interests.

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大學科系興趣導向分類系統和本土興趣模式之初探研究

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大學科系分類系統是整理高等教育資料的依據，大學科系興趣模式協助學生大學科系興趣的探索。國內使用的中華民國學科標準分類和十八學群，屬於專家導向分類系統。Holland（1959, 1997）興趣模式則常被用來建製大學科系的興趣導向分類系統，以協助學生探索大學科系興趣。然而，Holland（1959）興趣類型模式源自美國人對職業的興趣，目前研究雖證實Holland（1997）類型在國內的適用性，但尚未有研究去探索國內大學科系興趣架構的實際面貌。此研究依據國內高中生對於大學科系興趣，建立興趣導向的大學科系分類系統和大學科系興趣模式。1306位高三學生填寫他們對於166個大學科系的喜好程度，此166個大學科系取自中華民國學科標準分類系統。完整連結式群集分析（complete-linkage cluster analysis）結果得到三階層式的大學科系分類系統。此三階層分別為：166個科系、26個學群和7個領域。多向度標定分析（multidimensional scaling）把26個學群標定在三個向度，形成大學科系興趣模式。此三向度分別是：學習內容（物體—人心）、科系特質（動態—結構），以及功能目的（溝通—發現）。研究結果對照到中華民國學科標準分類、十八學群和Holland（1997）興趣類型，並討論相關應用。

關鍵詞：大學科系、本土、興趣模型、興趣導向分類系統