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## PROFESSIONAL EDUCATION & TRAINING | RESEARCH ARTICLE

# Analyzing the moderating effect of knowledge innovation of tourism and hospitality department teachers on student creative self-efficacy and innovation behaviors by using hierarchical linear modeling

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**Abstract:** This study aims to explore how the tourism and hospitality department promotes the influence of teachers' knowledge innovation on students' creativity self-efficacy and innovation behaviors. Taking teachers and students in tourism and hospitality departments of 30 universities and colleges in Taiwan as subjects and analyzed by hierarchical linear modeling. It is found that knowledge application of teachers' knowledge innovation has positive moderation effect on students' creativity self-efficacy and students' innovation behaviors. Knowledge generation has negative moderation effect on students' creativity self-efficacy and students' innovation behaviors. However, teachers' knowledge innovation does not influence students' innovative behavior. Their knowledge innovation will influence students' innovative behavior on the premise that the interaction effect of lecturers' knowledge innovation and students' self-efficacy happens. Therefore, university and

### ABOUT THE AUTHOR

Yuan-Cheng Chang conceived the idea and design and also completed the literature collection, literature review, method, data collection, and analysis of the results and manuscript. The final version is approved and ready for publication. The study results reveal that teachers' knowledge innovation was not only ineffective in boosting innovation behaviors among students, but it also exerted negative effects on students' creative self-efficacy and innovation behavior. Therefore, when promoting knowledge innovation, schools should prevent teachers from expending too much time on knowledge acquisition and neglecting their most crucial task—teaching—which would otherwise generate reverse effect. Schools should properly plan knowledge innovation for teachers, conduct evaluations and improvements, and encourage teachers to attach equal importance to both knowledge innovation tasks and teaching.

### PUBLIC INTEREST STATEMENT

This study explored the moderating effect of teachers' knowledge innovation on students' creative self-efficacy and innovation behaviors in order to ascertain and verify the effectiveness of teachers' knowledge innovation-related activities in improving the performance of students' innovation behavior under the influence of their creative self-efficacy. The result shows that teachers' knowledge innovation does not have a direct influence on students' innovative behavior. However, the interaction effect of teachers' knowledge innovation and students' creative self-efficacy has a negative effect on students' innovative behavior.

This result is probably attributed to teachers spend too much time on acquiring new knowledge, but neglect to foster their students' creative thinking. Students who have confidence in their originality and ideas feel depressed without their teachers' support and encouragement at the right time. As a result, students do not know how to innovate and have no confidence in themselves, which has a negative influence on their innovative behavior.

college should value and increase students' innovation self-behaviors and properly plan teachers' knowledge innovation to help students on innovation behavior performance and development.

**Subjects: Educational Research; Higher Education; Teaching & Learning; Creativity**

**Keywords: knowledge innovation; creativity self-efficacy; innovation behavior**

## 1. Introduction

Tourism industry has gained increased prominence in Taiwan's economic development as the country opens access to foreign visitors, and the lifestyle of Taiwanese citizens changes. The number of tourists who visited Taiwan in 2014 reached 9,906,201, a growth of approximately 24% compared with that in 2013. In addition, visitor expenditure amounted to NT\$437 billion (Taiwan Tourist Hotel Association, 2015). As tourism industry develops, human resource quality and training programs have become the key factor in the development of the tourism and hospitality industry. Subsequently, universities and colleges nationwide have established tourism and hospitality (hereafter referred to as "T&H") departments, and the number of students enrolled in such department has increased constantly. According to the Ministry of Education Republic of China (2015), the top three departments with the most substantial growth in number of students for the academic years 2009–2014 included hospitality, food and beverage management, and tourism, demonstrating, in total, an increase of 20,460 in number of students. However, the establishment of T&H department has intensified competition among schools. All competing schools have used innovative approaches to seek uniqueness and attract student enrollment. Consequently, the development of T&H departments is oriented toward innovation and cultivation of students with innovation capability.

Drucker (2002) indicated that continual innovation is the fundamental requirement for the survival of an organization. In a complex, competitive environment, innovation is pivotal to organizations seeking sustainability (Kearney, Gebert & Voelpel, 2009). Organizations must build knowledge-based innovation capability, and this knowledge innovation is the principal factor influencing whether the organization can sustain its competitive advantages (Barney, 1991). Knowledge innovation enables the organization to successfully make adjustments and survive in a constantly changing environment. Hence, practitioners have placed their attention on knowledge innovation (Bell, 2005; Emsley, 2005; Muthusamy, Wheeler, & Simmons, 2005). Knowledge innovation helps schools to overcome external challenges (Hsiao, 2008; Tseng, Yang, Chen, & Tseng, 2005) and pursue sustainable development. Teachers are the main promoters of knowledge innovation, as well as the source of emanation of knowledge innovation. They share and apply their own knowledge and externally acquired knowledge to their organization and in class. Therefore, the present study adopted teachers' knowledge innovation as a main research variable.

Schools provide the ground to inspire and cultivate students' knowledge and innovation capabilities (Wu & Huang, 2002). Schools also aggressively foster students with innovation capability, which helps students respond to future employment challenges. Gong, Huang, and Farh (2009) studied innovation behavior and found that creative self-efficacy directly predicts innovation behavior (Jaussi, Randel, & Dionne, 2007; Tinerney & Farmer, 2002). Creative self-efficacy refers to individuals' belief in their ability to produce creative work (Tinerney & Farmer, 2002). This finding inspired the present study to investigate whether the creative self-efficacy of students from T&H department influences students' innovation behavior.

Bandura (1977) integrated concepts of cognition theory and social learning to propose social learning theory, which elucidates human behavior according to the interactions and influences among a person's personality, behavior, and environment. Individual learning occurs through observation and imitation, and learning behavior differs according to environmental influence. Factor of social learning at the individual level is self-efficacy. The variables examined in the

present study were teachers' knowledge innovation, student creative self-efficacy, and student innovation behavior. Therefore, the present study adopted social learning theory as the research framework, creative self-efficacy and innovation behaviors as individual and behavioral constructs of individual-level factors, and teachers' knowledge innovation as environmental factor. Subsequently, this study explored the relationships among the research framework, factors at the individual level, and environmental factors and examined the moderating effect of teachers' knowledge innovation on students' creative self-efficacy and innovation behaviors in order to ascertain and verify the effectiveness of knowledge innovation-related activities in improving the performance of students' innovation behavior under the influence of their creative self-efficacy.

Furthermore, teachers and students are concepts at different levels, but the approaches to analyzing innovation topics are largely on a single level (Ostroff & Bowen, 2000). Therefore, the present study adopted multilevel perspectives to conduct investigations, using hierarchical linear modeling (HLM) for data analysis to elucidate the current status regarding the effects of T&H departments in promoting teachers' knowledge innovation, to examine the effects of students' creative self-efficacy on their innovation behavior, and to contribute toward studies on student innovation behaviors.

This study investigated the effect that knowledge innovation in teachers of T&H departments has on students' creative self-efficacy and innovation behaviors. In addition, the moderating effect of teachers' knowledge innovation was examined. HLM was subsequently employed for multilevel analysis. The objectives of this study are as follows:

- (1) To investigate the effects of students' creative self-efficacy on their innovation behaviors;
- (2) To investigate the effects of teachers' knowledge innovation on students' innovation behaviors;
- (3) To investigate the effects of teachers' knowledge innovation on students' creative self-efficacy;
- (4) To investigate whether teachers' knowledge innovation moderates the relationship between students' creative self-efficacy and their innovation behaviors; and
- (5) To provide valuable references for T&H departments and subsequent scholars according to discussions and recommendations based on the results of this study.

## 2. Literature review

### 2.1 Creative self-efficacy and innovation behavior

According to Bandura (1977) developed the self-efficacy concept, defining it as learners' belief in themselves to achieve success. This belief is founded on their self-assessment of whether they are capable of completing a behavior. However, although general self-efficacy is positively related to individual creative self-efficacy, it cannot be analogized to measures of self-efficacy in different domains (Chen, Gully, & Eden, 2001; Tierney & Farmer, 2002). Consequently, Tierney and Farmer (2002) defined creative self-efficacy as a person's belief that he/she is capable of producing creative works. Tierney also found that creative self-efficacy can directly elicit innovation behavior, and these two factors influence individual creativity. Hence, creative self-efficacy is also the principal determinant of innovation behavior.

Regarding innovation behavior, Kanter (1988) innovation is related to idea generation and idea realization. Innovation behavior is composed of three stages: solutions and adoptions of innovation ideas generated; innovator seeking assistance for the generated idea; and innovator taking action to realize the idea. Scott and Burce (1994) also proposed three dimensions of innovation behavior: idea generation, idea promotion, and idea realization. However, individual innovation behavior is not confined the technological changes; it also comprises creativity, implementation process, and innovation behavior (West & Anderson, 1996). Jong and Hartog (2007) viewed innovation behavior as multidimensional, with its core concept being the behaviors generated during the procedure through which employees engage in innovation. At the beginning, loopholes or problems occur at

the implementation level, in which employees seek opportunities and generate ideas. At the application stage, employees play a critical behavioral role by; at the innovation stage, employees engage in behaviors that aim at idea verification. For this reason, innovation behavior is the key to organizational innovation and also a crucial element of organizational innovative development. Therefore, innovation behavior involves learners generating innovative ideas and problem solutions during innovation activities through which they demonstrate the ability to practice innovation.

Bandura (1997) asserted that high-level self-efficacy is the prerequisite for creativity and new knowledge discovery; it motivates individuals to be creative and also influences their future innovation behavior and performance (Ford, 1996). Creative self-efficacy studies have also determined that creative self-efficacy effectively predicts individual innovation behavior and performance (Gong et al., 2009; Tinerney & Farmer, 2002) and that students' creative self-efficacy plays a pivotal role in their innovation behavior and performance (Chang & Yang, 2012; Cheng, Shiu, & Chuang, 2012; Huang & Hung, 2009). Therefore, a high level of creative self-efficacy represents enhanced innovation behavior. This study proposes the following hypothesis:

**H<sub>1</sub>:** Student creative self-efficacy positively significantly influences innovation behavior

## **2.2 Knowledge innovation and innovation behavior**

Knowledge is characterized by transferability, capacity for aggregation, appropriability, specialization in knowledge acquisition, and knowledge requirements of production. Organizations can create value through knowledge; therefore, knowledge can be transferred, converted, shared, applied, and stored to achieve efficient knowledge creation and innovation (Grant, 1996). In addition, Nonaka and Takeuchi (1995) claimed that knowledge creation and innovation are derived from an interaction and conversion between implicit and explicit knowledge. Knowledge innovation is predominantly based on personal experience and intuitive implicit knowledge; it occurs through interpersonal interactions. The accumulation and absorption of knowledge capital are the foundations of knowledge innovation. Consequently, the level of knowledge capital transferred within an organization influences individual knowledge innovation.

Regarding knowledge innovation, Shen and Li (2008) identified that knowledge innovation enhances an organization's innovation capability to an extent that the organization can sustain its competitive advantage. In reference to studies conducted by Damanpour and Evan (1984), Tidd, Bessant, and Pavitt (2001), and Higgins (1995), Shen further classified knowledge innovation into product innovation, process innovation, management innovation, and market innovation. Hsiao (2008) Knowledge innovation is subdivided into four dimensions including organization situation, knowledge production, knowledge application, and knowledge dissemination. Tseng et al. (2005) conducted a study on feasible strategies for knowledge innovation in elementary schools; Tseng et al. (2005) found that adequate knowledge, benchmark learning, topic discussion, ability to act according to circumstances, and capability to integrate new and old experiences positively influence teachers' knowledge innovation. Moreover, activities teachers undertake at school are knowledge based. If they can effectively engage in knowledge-based innovation, then they can determine the trends of knowledge and foster students with creative thinking and problem-solving skills.

Wang (2002) also reported that knowledge innovation benefits teaching quality at schools, establishes teaching effectiveness, and improves students' learning performance and creative performance. Teachers' knowledge innovation primarily involves nurturing students' future capabilities. In knowledge innovation, teachers can summarize, analyze, and organize teaching materials; integrate teaching scenarios with teaching strategies; and combine innovative and creative teaching methods and materials. In doing so, they can help students to improve their knowledge on innovation and innovation capability (Lin, 2000; Wang, 2002). This study proposes the following hypothesis:

**H<sub>2</sub>:** Teachers' knowledge innovation positively significantly influences students' innovation behavior

### **2.3 Knowledge innovation, creative self-efficacy, and innovation behavior**

Bandura (1986) proposed social learning theory, positing that a person is influenced by the environment and has the cognitive ability to actively select and influence the environment; that behavior is influenced by the environment, but behavioral outcome also changes the environment; and that individual cognition influences behavior but is also subjected to the influence of behavioral outcome. In addition, human behavior is explained by using the interactive and influential relationship among behavior, personal factors, and environmental factors (Bandura, 1986; Hunter, Bedell, & Mumford, 2007). Members of an organization tend to exhibit greater motivation and cognition to engage in innovation activities when they subjectively perceive that the environment in which they reside emits positive climate for innovation and that their organization supports and encourages innovation behavior. Members with such perception tend to achieve innovation performance (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Baer & Frese, 2003; Kark & Carmeli, 2009).

Wu and Huang (2002) reported that schools not only disseminate knowledge but also create knowledge. When knowledge recipient has a high level of self-efficacy in an organization, knowledge innovation in the organization is more effective. If students can learn in an environment where innovative thinking is encouraged and supported and where support from significant others is received, then students can demonstrate improved innovation capability (Csikszentmihalyi, 1999; Mayer, 1999). Individual creative self-efficacy is prone to influence from new school technologies and facilities (Aliakbari, 2015); moreover, Beghetto (2006) verified the effect of teachers and teaching environment on students' creative self-efficacy. The aforementioned results show that if school teachers share their knowledge innovation experiences in class, then it will help students to improve their creative self-efficacy. This study proposes the following hypothesis:

**H<sub>3</sub>:** Teachers' knowledge innovation positively influences students' creative self-efficacy

Hsu and Fan (2006) suggested combining individual positive perception toward organizational context and innovation vitality toward individual confidence in innovation because, together, they can explain members' innovation behavior. Bammens (2015) found that an innovation-supporting organizational environment and employee motivation crucially influence employees' innovation behavior. Numerous scholars have maintained investigating individual creativity and innovation capability from environmental perspective. In particular, interaction between the environment and individual cognition exerts an influence on individual creativity and innovation capability (Amabile et al., 1996; Bammens, 2015; Csikszentmihalyi, 1999; Hunter et al., 2007; Simonton, 1997). Individual innovation behavior is exposed to the interactive effect between the environment and creative self-efficacy (Tinerney & Farmer, 2002). In an environment where innovation is supported, employees exhibit higher creative self-efficacy and thereby show better innovation behavior (Jaiswal & Dhar, 2015). School climate for innovation influences students' creative self-efficacy and innovation behaviors (Chang & Yang, 2012), indicating that distinct innovation environment in schools and students' level of cognition regarding innovation generate an effect on students' capability to innovate.

The study infers that the interaction between teachers' knowledge innovation (the school environmental factor) and students' creative self-efficacy has a positive effect on students' innovation behavior. Moreover, knowledge generation, knowledge production, knowledge application, and knowledge dissemination have an influence on innovation behavior. Yuan and Marquardt's (2015) management research on innovative behavior focuses on the human aspect. The body of work applies theories from disciplines such as psychology and sociology to understanding situations and factors that influence the innovative behavior of individuals and groups in the organizational setting. The employees' readiness to implement innovations is dictated by their perception of the innovation process and the innovation situation (Kabasheva, Rudaleva, Bulnina, &

Askhatova, 2015). Gilan-Deh and Chamanzamin's (2016) findings suggest that there is a significant positive relationship between knowledge management and its aspects with innovative behavior. Also regarding respondents, the highest average in ranking is knowledge application.

The production of knowledge and its development is a fundamental activity in any innovation system (Edquist, 2011). Innovation policy must secure the diversity of knowledge production and R&D activities and a certain balance between different types of R&D activities (Borrás & Edquist, 2015). Khoo, Yeap, and Ramayah (2014) found that in highly dynamic environmental conditions, the impact of knowledge dissemination on process innovation is enhanced during highly dynamic environmental conditions. Darroch (2005) postulated and proved that knowledge dissemination positively affect innovation. Therefore, when teachers teach by application and dissemination their new knowledge, which would boost students' confidence in their creative ideas and creations, students would be more motivated to engage in innovation behaviors. This study proposes the following hypothesis:

**H<sub>4</sub>:** Teachers' knowledge innovation moderates the relationship between students' creative self-efficacy and innovation behaviors

**H<sub>4-1</sub>:** Teachers' organization situation moderates the relationship between students' creative self-efficacy and innovation behaviors

**H<sub>4-2</sub>:** Teachers' knowledge production moderates the relationship between students' creative self-efficacy and innovation behaviors

**H<sub>4-3</sub>:** Teachers' knowledge application moderates the relationship between students' creative self-efficacy and innovation behaviors

**H<sub>4-4</sub>:** Teachers' knowledge dissemination moderates the relationship between students' creative self-efficacy and innovation behaviors

### 3. Research method

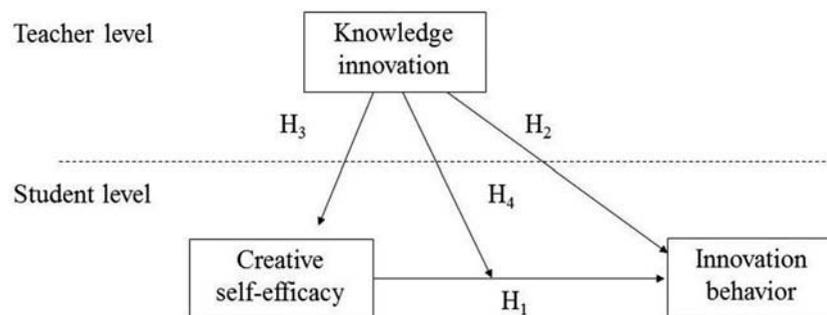
#### 3.1 Research framework

With the social learning theory as the research framework, this study adopted HLM for analysis, using teachers' knowledge innovation as the environmental factor at the teacher level and student creative self-efficacy as individual and behavioral factors, respectively, at the student level. This structure forms the study's research framework as shown in Figure 1.

#### 3.2 Questionnaire design and sampling

This study investigated the relationship of teachers' knowledge innovation with student creative self-efficacy and innovation behavior, focusing on T&H department teachers and students as the

Figure 1. Research framework.



research subjects. Regarding teachers, knowledge innovation scale was used to elucidate the implementation outcomes of knowledge innovation in T&H departments. The Organizational Knowledge Innovation Scale developed by Hsiao (2008) was adopted. Five T&H expert scholars were invited to revise the scale before the scale dimensions and items were evaluated. The four dimensions of the scale (i.e., organizational situation, knowledge production, knowledge application, and knowledge dissemination) were revised as such that they contained a total of 78 items, and this scale fulfilled evaluation standard (NC = 2.89, GFI > .95, AGFI > .95, NFI > .90, NNFI > .90, RMSEA = .92). Organizational situation includes working environment, award system, organizational learning, and use of resources; knowledge production includes knowledge creation and knowledge acquisition; knowledge application includes knowledge transfer and knowledge assessment; and knowledge dissemination includes knowledge diffusion and knowledge sharing (Hsiao, 2008).

Regarding students, the Scale of Creative Self-efficacy for Students (Huang & Hung, 2009) and Innovation Behavior Scale (Kleysen & Stree, 2001) were used. The dimensions of the creative self-efficacy scale (i.e., creative thinking, belief in creative production, and resistance against negative evaluations) were revised, yielding 12 items. This scale fulfilled evaluation standard (NC = 2.78, GFI > .95, AGFI > .95, NFI > .95, NNFI > .95, RMSEA < .05, SRMR < .05). The innovation behavior scale was composed of opportunity exploration, generativity, formative investigation, championing, and application and contained 14 items in total and an alpha reliability of .95.

Purposive sampling approach was employed to sample 2 teachers and 15 students each from the T&H departments of 30 college schools across Taiwan. The questionnaires were distributed only after teacher consent was obtained. In total, questionnaires were delivered to 60 teachers and 450 students, from which 43 and 379 valid questionnaires were returned, respectively.

### 3.3 Research instrument

The research instruments applied in this study included a knowledge innovation scale, creative self-efficacy scale, and innovation behavior scale. In addition, exploratory factor analysis (EFA) and reliability analysis were used to conduct a pretest on the scales; subsequently, confirmatory factor analysis (CFA) was performed on the official scales to measure the construct validity and goodness of fit of the scales used.

#### (1) Knowledge innovation

Knowledge innovation was composed of four dimensions: organizational situation, knowledge production, knowledge application, and knowledge dissemination. Organizational situation items that do not meet reliability standards were deleted, including Items 8, 9, and 21. The Cronbach's  $\alpha$  of organizational situation was .924, and the Cronbach's  $\alpha$  values of various factors under this dimension were all greater than .7, exceeding the standard recommended by Nunnally (1978). The Cronbach's  $\alpha$  of knowledge production was .948, and the Cronbach's  $\alpha$  values of various factors under this dimension were all greater than .7. Items 1 and 9 of knowledge application did not meet reliability standard and were therefore eliminated; the Cronbach's  $\alpha$  of this dimension was .961. Items 11, 12, and 13 of knowledge dissemination did not meet reliability standard and were therefore eliminated; the Cronbach's  $\alpha$  of this dimension was .947, and the Cronbach's  $\alpha$  values of various factors under this dimension were all greater than .7.

This study adopted CFA to examine the degree of fit of the scale. The results indicated that except for root mean square residual (RMR = .084 > .05), standardized RMR (SRMR = .063 > .05), root mean square error of approximation (RMSEA = .09 > .08), and normed chi-square (NC = 4.7 > 3), which were all relatively acceptable, the remaining indices met the evaluation standards (goodness of fit index [GFI] = .89 > .80, adjusted goodness of fit index [AGFI] = .82 > .80, parsimony normed fit index [PNFI] = .66 > .50, parsimony goodness of fit index [PGFI] = .56 > .50, normed fit index [NFI] = .90 > .90, non-normed fit index [NNFI] = .90 > .90, comparative fit index [CFI] = .90 > .90, and incremental fit index [IFI] = .91 > .90). The factor loadings of each dimension and item ranged between .65 and .89, fulfilling the standard of fit (Bagozzi & Yi, 1988).

## (2) Creative self-efficacy

EFA was performed, yielding Kaiser–Meyer–Olkin (KMO) value of .848 with cumulative explained variance of 53.322%. Items 10 and 12 were deleted because their average variance extracted (AVE) values were less than .5. Next, second EFA was performed, yielding KMO of .841 with a cumulative explained variance of 58.951%. AVE values were greater than .5 and factor loadings were greater than .6. Subsequently, creative self-efficacy was divided into three dimensions: (a) Creative thinking (Items 1, 2, 3, and 9); (b) belief in creative production (Items 4, 5, 6, and 7); and (c) resistance against negative evaluations (Items 8 and 11). In terms of reliability, the Cronbach's  $\alpha$  of creative self-efficacy was .756; the Cronbach's  $\alpha$  values of the three dimensions were .709, .775, and .688, respectively.

The creative self-efficacy scale was then examined using CFA. In terms of absolute fit indices, GFI = .95 > .80, AGFI = .91 > .80, RMR = .045 < .05, SRMR = .048 < .05, and RMSEA = .076 < .08. In terms of parsimony fit indices, NC = 2.179 < 3, PNFI = .68 > .50, and PGFI = .55 > .50. In terms of incremental fit indices, NFI = .96 > .90, NNFI = .96 > .90, CFI = .97 > .90, and IFI = .97 > .90. These results indicate that the indices of creative self-efficacy scale fulfilled evaluation standard. The factor loadings of each dimension and item ranged between .64 and .76, fulfilling the standard of fit (Bagozzi & Yi, 1988).

## (3) Innovation behavior

Regarding innovation behavior, EFA was performed, yielding KMO value of .896 with cumulative explained variance of 53.393%. Items 13 and 14 were deleted because their AVE values were less than .5. Next, the second EFA was performed, yielding KMO of .888 with a cumulative explained variance of 54.766%. AVE values were greater than .4 and factor loadings were greater than .6. Subsequently, innovation behavior (Items 3, 4, and 5) was further branched into three dimensions: (a) motivation to innovate (Items 6, 7, and 8); (b) innovation application (Items 1, 2, and 9); and (c) searching and identification (Items 10, 11, and 12). In terms of reliability, the Cronbach's  $\alpha$  of innovation behavior was .841; the Cronbach's  $\alpha$  values of the remaining three dimensions were .793, .686, and .664, respectively.

The innovation behavior scale was then examined using CFA. Except for RMR, SRMR, RMSEA, and NC, which were all relatively acceptable (RMR = .072 > .05, SRMR = .055 > .05, RNSEA = .083 > .08, and NC = 4.5 > 3), the remaining indices satisfied the evaluation standard (GFI = .91 > .80, AGFI = .86 > .80, PNFI = .711 > .50, PGFI = .583 > .50, NFI = .94 > .90, NNFI = .93 > .90, CFI = .95 > .90, and IFI = .95 > .90), indicating that the indices fell within the acceptable range. The factor loadings of each dimension and item ranged between .55 and .82, fulfilling the standard of fit.

## 4. Results

For this study, 43 and 370 valid questionnaires were returned from teachers and students, respectively. Regarding the demographics of teachers, there were 22 male teachers and 21 female teachers. Their age was in the ranges of  $\leq 29$  years ( $n = 1$ ); 30–39 years ( $n = 10$ ); 40–49 years ( $n = 19$ ); and 50–59 years ( $n = 13$ ). The teachers had completed bachelor's degree ( $n = 1$ ), masters ( $n = 16$ ), and doctorate ( $n = 26$ ) and attended general universities ( $n = 11$ ), university of science and technology ( $n = 25$ ), vocational schools ( $n = 6$ ), and institute of technology ( $n = 1$ ). There were 13 vocational and technical teachers and 30 full-time teachers. The teachers had different years of experience in teaching, including  $\leq 5$  years ( $n = 16$ ), 6–10 years ( $n = 8$ ), 11–15 years ( $n = 10$ ), 16–20 years ( $n = 3$ ), and 21–25 years ( $n = 6$ ).

This study adopted HLP to analyze the proposed hypotheses and to investigate the relationship of teachers' knowledge innovation with students' creative self-efficacy and innovation behaviors. Before HLM was performed, within-group consistency (Klein & Kozlowski, 2000) and difference in between-group variance (James, Demaree, & Wolf, 1993) among the contextual variables of this study must be determined.

#### 4.1 Null model

During HLM, null model must be used to examine the presence or absence of multilevel effects before slope-as-outcomes and intercept-as-outcomes analysis can be conducted. When intraclass correlation (ICC) value is greater than .059 (Wen, 2006) and ICC2 is greater than .50 (James et al., 1993), between-group variance exhibits significant difference. Subsequently, multilevel statistical analysis must be considered. This study adopted creative self-efficacy and innovation behavior as the dependent variables; therefore, null model analysis was performed first.

##### (1) Innovation behavior

Between-group variance component value was .012, achieving significant level ( $\chi^2 = 52.808$ ,  $df = 29$ ). Within-group variance component value was .187, satisfying the requirement of HLM analysis regarding between-group and within-group variation of dependent variables (Gavin & Hofmann, 2002). ICC was  $.012/ (.012 + .187) = .061$  and ICC2 was .518. Only 6.1% of the variation emanated from school level, whereas the remaining 93.9% of variation was attributed to students.

##### (2) Creative self-efficacy

Between-group variance component value was .012, achieving significant level ( $\chi^2 = 50.445$ ,  $df = 29$ ). Within-group variance component value was .200, satisfying the requirement of HLM analysis regarding between-group and within-group variation of dependent variables (Gavin & Hofmann, 2002). ICC was  $.012/ (.012 + .200) = .057$  and ICC2 was .511. Only 5.7% of the variation in students' creative self-efficacy was attributed to different teachers, and this result achieved significant level. In other words, students who are taught by different teachers exhibit distinct creative self-efficacy.

#### 4.2 Random-coefficients regression model

##### (1) Effect of student creative self-efficacy on innovation behavior

According to the random effect model shown in Table 2, creative self-efficacy achieved significant level ( $\gamma_{10} = .562$ ,  $se = .039$ ,  $t = 14.488$ ,  $p < .001$ ), indicating that students' creative self-efficacy positively significantly influences their innovation behavior. The findings concur with the findings of Gong et al. (2009), Chang and Yang (2012), Cheng et al. (2012), and Huang and Hung (2009). Students with stronger creative self-efficacy are more likely to higher levels of innovation behavior and thus higher innovation behavior when they perceive strong confidence and support. Thus, H1 was supported.

##### (2) Effect of teachers' knowledge innovation and students' innovation behavior

Table 1 shows that the dimensions under teachers' knowledge innovation, namely organizational situation ( $\gamma_{01} = .046$ ,  $se = .122$ ,  $t = .375$ ,  $p > .05$ ), knowledge production ( $\gamma_{02} = -.111$ ,  $se = .125$ ,  $t = -.892$ ,  $p > .05$ ), knowledge application ( $\gamma_{03} = .028$ ,  $se = .089$ ,  $t = .318$ ,  $p > .05$ ), and knowledge dissemination ( $\gamma_{04} = .007$ ,  $se = .106$ ,  $t = .068$ ,  $p > .05$ ), did not achieve significant level. This result indicates that knowledge innovation exerted no significant influence on students' innovation behavior. The result is different from that of Beghetto (2006). Thus, H<sub>2</sub> was not supported.

##### (3) Effect of teachers' knowledge innovation and students' creative self-efficacy

Table 1 shows that knowledge production ( $\gamma_{02} = -.176$ ,  $se = .082$ ,  $t = -2.152$ ,  $p < .05$ ) exerted a negative significant influence on students' creative self-efficacy, whereas organizational situation ( $\gamma_{01} = -.092$ ,  $se = .106$ ,  $t = -.862$ ,  $p > .05$ ), knowledge application ( $\gamma_{03} = .033$ ,  $se = .086$ ,  $t = .383$ ,  $p > .05$ ), and knowledge dissemination ( $\gamma_{04} = .124$ ,  $se = .091$ ,  $t = 1.358$ ,  $p > .05$ ) did not achieve significant level. These results suggest that knowledge innovation exerted no significant influence on students' creative self-efficacy. Therefore, H<sub>3</sub> was not supported.

**Table 1. Summary of the effects that teacher knowledge innovation has on student creative self-efficacy and innovation behavior**

Model	Creative self-efficacy		Innovation behavior	
	Coefficient	t	Coefficient	t
$\gamma_{00}$	4.023	11.650***	3.910	11.713***
Organizational situation $\gamma_{01}$	-.092	-.862	.046	.420
Knowledge production $\gamma_{02}$	-.176	-2.152*	-.111	-1.079
Knowledge application $\gamma_{03}$	.033	.383	.028	.458
Knowledge dissemination $\gamma_{04}$	.124	1.358	.007	.119
Random effect	Variance	$\chi^2$	Variance	$\chi^2$
$\tau_{00}$	.010	40.360*	.016	51.106**
$\sigma^2$	.201		.188	

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

#### 4.3. Slope-as-outcomes model

Slope-as-outcomes model shown in Table 2 reveals that organizational situation ( $\gamma_{11} = .076$ ,  $se = .150$ ,  $t = .503$ ,  $p > .05$ ) and knowledge dissemination ( $\gamma_{14} = -.030$ ,  $se = .080$ ,  $t = -.373$ ,  $p > .05$ ) exerted no significant moderating effect on the relationship between students' creative self-efficacy and innovation behavior. Therefore,  $H_{4-1}$  and  $H_{4-4}$  were not supported.

Knowledge production under knowledge innovation exerts negative moderating effect on the relationship between students' creative self-efficacy and innovation behavior ( $\gamma_{12} = -.288$ ,  $se = .133$ ,  $t = -2.163$ ,  $p < .05$ ). Therefore,  $H_{4-2}$  was supported. Moreover, Figure 2 shows that when the level of teachers' knowledge production is high, students tend to exhibit a high level of creative self-efficacy but seldom engage in innovation behavior. Teachers, who spend too much time on acquiring new knowledge and neglect their students' mind and internal need (Li, 2007), have a negative influence on the students' innovative behavior. Furthermore, students who have confidence in their originality feel depressed without their teachers' care and support (Liu, 2005).

Knowledge application under knowledge innovation exerts positive moderating effect on the relationship between students' creative self-efficacy and innovation behavior ( $\gamma_{13} = .212$ ,  $se = .093$ ,  $t = 2.271$ ,  $p < .05$ ), and  $H_{4-3}$  was supported. Figure 3 shows that when the level of teachers' knowledge application is high and students exhibit a high level of creative self-efficacy, students are motivated to engage in innovation behavior (Bammens, 2015; Jaiswal & Dhar, 2015). Therefore, students will have better innovative behavior if teachers apply their knowledge innovation to their courses and support their students to innovate.

### 5. Conclusion and recommendations

In light of the rapid growth and changes in the T&H industry, schools respond by using innovative approaches to changing their environment, establishing department characteristics, strengthening teacher innovation capability, and fostering student innovation capacity. Therefore, this study investigated the relationship that the knowledge innovation of T&H department teachers has with students' creative self-efficacy and innovation behavior. Finally, conclusion and recommendations were drawn on the basis of the study results.

#### 5.1 Conclusion

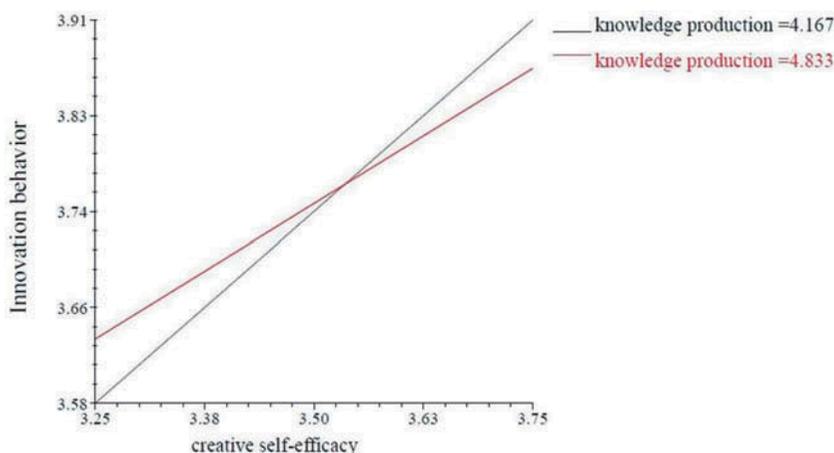
The study aims to explore the influence of teachers' knowledge innovation and students' creative self-efficacy on students' innovative behavior. The result shows that teachers' knowledge innovation does

**Table 2. Summary of the moderating effect of teachers' knowledge innovation**

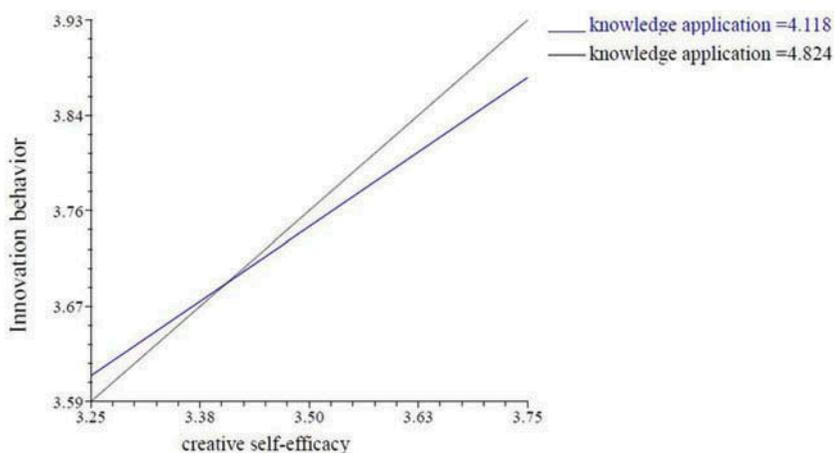
Model	Random prediction model		Intercept-as-outcomes model		Slope-as-outcomes model	
	Coefficient	t	Coefficient	t	Coefficient	t
$\gamma_{00}$	1.786	12.938***	1.635	5.417***	.998	1.033
Organizational situation $\gamma_{01}$			.095	1.179	-.192	-.341
Knowledge production $\gamma_{02}$			-.010	-.133	1.019	2.118*
Knowledge application $\gamma_{03}$			.010	.230	-.722	-2.204*
Knowledge dissemination $\gamma_{04}$			-.062	-1.342	.040	.139
Creative self-efficacy $\gamma_{10}$	.562	14.488***	.567	14.824***	.739	2.541*
Organization situation* Creative self-efficacy $\gamma_{11}$					.076	.503
Knowledge production* Creative self-efficacy $\gamma_{12}$					-.288	-2.163*
Knowledge application* Creative self-efficacy $\gamma_{13}$					.212	2.271*
Knowledge dissemination* Creative self-efficacy $\gamma_{14}$					.030	-.373
Random effect	Variance	$X^2$	Variance	$X^2$	Variance	$X^2$
$\tau_{00}$	.004	23.686	.006	39.607*	.031	20.586
$\tau_{10}$	.001	23.604			.003	20.300
$\sigma^2$	.127		.127		.127	

\* $p < .05$ , \*\*\* $p < .001$ .

**Figure 2. Moderating effect of teachers' knowledge innovation on the relationship between students' creation self-efficacy and innovation behavior.**



**Figure 3. Moderation effect of teachers' knowledge innovation on the relationship between students' creation self-efficacy and innovation behavior.**



not have a direct influence on students' innovative behavior. However, the interaction effect of teachers' knowledge innovation and students' creative self-efficacy has a positive effect on students' innovative behavior. In other words, teachers' knowledge innovation will positively influence students' innovative behavior on the premise that the interaction effect of teachers' knowledge innovation and students' creative self-efficacy happens. The relationship between variables is discussed as follows:

(1) Student creative self-efficacy positively influences innovation behavior

Students' creative self-efficacy generated a positive effect on their innovation behavior; this result accords with that of Tinerney and Farmer (2002), who found that if students perceive their ability to undergo creative thinking, produce creative works, accept challenges, and resist negative evaluations, then they will perform better in terms of innovation motivation, application, and behavior. Conversely, if students deem themselves as being incapable of generating creative ideas, producing creative works, and tolerating criticisms, then they are unlikely to engage in innovation behavior. Therefore, attention must be paid to students' creative self-efficacy in order to motivate or cultivate innovation behavior in students.

(2) Teachers' knowledge innovation exerts no influence on students' innovation behavior

Implementing knowledge innovation practice at school posed no tangible benefit on students' innovation behavior. In other words, despite schools' effort in improving teachers' knowledge

innovation capabilities with regard to organizational situation, knowledge production, knowledge application, and knowledge dissemination, it exerts no direct positive effect on students' innovation behavior. Further exploring the reason underlying this result reveals that the teachers were not satisfied with the practice of knowledge innovation, producing satisfaction scores of 3 to 3.5 on average. Consequently, students cannot distinguish the difference in knowledge innovation-based teaching, and therefore, knowledge innovation exerted no influence on students.

- (3) Teachers' knowledge production during knowledge innovation negatively influences students' creative self-efficacy

When teachers engage in high level of knowledge production, students exhibit low level of creative self-efficacy. The result is probably attributed to the emphasis T&H department places on innovative knowledge generation. To actively acquire and create new knowledge, teachers tend to neglect students' creativity development (Sak, 2004). As a result, students lose confidence in their creativity. However, when teachers' knowledge production is low, teachers tend to have time to guide and assist students, allowing students to have confidence in their creative skills.

- (4) Teachers' knowledge production negatively moderates the relationship between students' creative self-efficacy and innovation behavior

The interaction between teachers' knowledge production and students' creative self-efficacy negatively influences students' innovation behavior. In other words, when teachers acquire and create new knowledge frequently, students generally exhibit poor performance in innovation behavior despite their confidence in generating creative ideas, producing creative works, and accepting criticisms. This result is probably attributed to teachers spend too much time on acquiring new knowledge, but neglect to foster their students' creative thinking (Sak, 2004). Students who have confidence in their originality and ideas feel depressed without their teachers' support and encouragement at the right time (Liu, 2005). As a result, students do not know how to innovate and have no confidence in themselves, which has a negative influence on their innovative behavior.

- (5) Teachers' knowledge application positively moderates the relationship between students' creative self-efficacy and innovation behavior

A high level of knowledge application by teachers and a high level of creative self-efficacy in students strengthen students' innovation behavior performance. This phenomenon is a result of teachers applying knowledge innovation (by knowledge transfer, evaluation, etc.) in teaching, which leads to the creation of an environment where innovative teaching is provided and development of an innovative teaching approach. In addition, this teaching practice imparts greater confidence in students regarding their ability to produce creative ideas, complete creative works, and tolerate criticisms. Subsequently, students are motivated to engage in innovation behaviors. Thus, when students hold beliefs about their creative skills, teachers' knowledge application is conducive to evoking students' innovation behavior. Furthermore, if teachers can apply innovative knowledge in teaching, it will effectively encourage innovation behaviors in students.

## 5.2 Recommendations

- (1) Underlining the importance of students' creative self-efficacy

The findings of this study revealed that students' creative self-efficacy positively affects their innovation behavior. In terms of moderating effect, creative self-efficacy promotes innovation behavior. Therefore, students' creative self-efficacy should be targeted when cultivating and enhancing their innovation behavior. Moreover, subsequent scholars can view creative self-efficacy as a crucial influencing variable when investigating the creativity or innovation behaviors of T&H department students.

(2) Schools should properly plan knowledge innovation-related operations for teachers

Schools promote teacher knowledge innovation to provide new insights for teachers and improve teachers' new professional knowledge and skills so that they can apply them in teaching. However, study results reveal that teachers' knowledge innovation was not only ineffective in boosting innovation behaviors among students, but it also exerted negative effects on students' creative self-efficacy and innovation behavior. Therefore, when promoting knowledge innovation, schools should prevent teachers from expending too much time on knowledge acquisition and neglecting their most crucial task—teaching—which would otherwise generate reverse effect. Schools should properly plan knowledge innovation for teachers, conduct evaluations and improvements, and encourage teachers to attach equal importance to both knowledge innovation tasks and teaching.

(3) Examining the effects of general T&H department teachers and vocational and technical teachers on students' innovation capability

Increase in the number of T&H departments in Taiwan has resulted in a shortage of T&H teachers. As a result, numerous schools employ vocational and technical teachers with relevant practical experience, believing that these teachers would be more helpful to improving students' practical skills. The investigation conducted in this study focused on only 30 general teachers and 13 vocational and technical teachers. The results indicated that vocational and technical teachers exhibited higher scores on students' creative self-efficacy and innovation behavior compared with general teachers, but the difference was nonsignificant. Therefore, this study recommends subsequent researchers to compare the effects of general teachers and vocational and technical teachers on students' innovation capability.

(3) Examining the effect of school innovation on students' innovation capability from multi-dimensional perspectives

This study also recommends future studies to investigate whether school innovation (e.g., organizational innovation, innovative leadership, teaching innovation, or course innovation) is beneficial for enhancing students' innovation capability. In addition, the difference in effect among private and public schools can be examined. Alternatively, the effect of innovation activities in T&H department can be examined from student perspectives. Thus, more informative results regarding innovation can be provided as reference for schools.

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