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Patent Applying or Not Applying: What Factors Motivating Students' Intention to Engage in Patent Activities

Mei-Lan Lin [1], Tai-Kuei Yu [2*]

[1] Department of Hospitality Management, Southern Taiwan University of Science and Technology, TAIWAN
[2] Department of Business Administration, National Quemoy University, TAIWAN

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ABSTRACT

This study aimed to examine the roles of growth need strength and the perceived benefits of innovation as antecedent predictors of students' intentions to participate in patent activities using the theory of planned behaviour (TPB). This study compared three models that predicted business and management students' intentions to perform patent activities. Results from structural equation modelling applied to undergraduate students supported that the effects of growth need strength and the perceived benefits of innovation influenced students' intentions through a TPB model with the antecedents of attitude, subjective norms, and perceived behavioral control. The research proposed model was superior to the other models and explained 74% of the variance in behavioral intentions to engage in patent activities. Implications and directions for future research are discussed.

Keywords: patent activities, growth need strength, perceived benefits, theory of planned behaviour model

INTRODUCTION

Universities providing higher education in business need to bridge the traditional boundaries among scientific, technological, and cultural bodies of knowledge (Cheng & Chu, 2016; Kim, 2015). A reorientation toward business as a subject matter is a necessary prerequisite for a critical analysis of the process underpinning education related to business. The curricula of business schools should rest on basic objective research and critical considerations related to both business practices and broader social interests and concerns. Business schools might consider incorporating approaches that facilitate the development of critical, analytic, and integrative thinking while emphasizing an innovation curriculum (Busing, & Palocsay, 2016). Only a few studies have investigated innovation and patent education in institutions of higher education, for example intellectual property education in business school (Gundry, Ofstein, & Monllor, 2016; Horwitch, & Stohr, 2012; Jabade, Abhyankar, & Ganguli, 2008; Mok, Sohn, & Ju, 2010). Although most of these discussed the nature of innovation education and the process of introducing this subject at a business school, they failed to examine what the major factors influence students' psychological needs to not only keep the intention on patent activities but also contribute into their career life.

The researchers received valuable feedback from students and employers. Most of the feedback was generally positive, and understanding of provisional patent applications, filings, the cost of patent litigation, and not squandering intellectual property were identified as most relevant skills for jobs in a firm (Horwitch, & Stohr, 2012; Kim, 2015). Jabade, Abhyankar, and Ganguli (2008) recommend integrating intellectual property rights (IPR) education into technical or business education, but the application of patent is not limited to technical issues. Innovation is important for national and industrial development and vital to create competitive value in entrepreneurial process (Gundry et al., 2016; Somaya, 2012). As a result, governments and universities around the world have been trying to stimulate innovativeness and address student concerns about turning new knowledge and skills into competitive advantage in the workplace (Clinebell, & Clinebell, 2008). University business departments have launched innovation-related courses such as creative thinking and intellectual property rights (IPR) management, which reflects increased job possibilities for managers (Horwitch, & Stohr, 2012) and

✉ mllin@stust.edu.tw ✉ yutk2000@gmail.com yutk2012@nqu.edu.tw **(*Correspondence)**

Contribution of this paper to the literature

- The extended TPB model combination with growth need strength and perceived benefits is increased much more explanatory power than simple TPB model, and also has better overall goodness of fit.
- The results indicate that students' attitudes had the strongest effect on their intention to patent activities and the extent of students' attitudes emerged from their growth need strength and perceived benefits.
- Patent activities is not limited to technical issues. Innovation is always market driven and consumer orientation. This study suggests entrepreneur team has cross-discipline members (especially business students) to avoid their risk of new product failure.

opportunities for entrepreneurs. Universities have also deepened their links with industry in order to focus on innovation, entrepreneurship, and diversified learning environments (Busing, & Palocsay, 2016). Many of patents have been developed at universities, where the institutions actively encourage students to apply not only for patents with the provision of advanced consultation services and financial assistance to students during the application process, but also for participants in international invention fairs where participants can display their creativity and become encouraged to pursue entrepreneurial careers. According to statistics of Taiwan Intellectual Property office, there are about 4300 university patents annual granted in recent five year (Liberty Times Net, 2016). Many Universities in Taiwan tried to build the innovative supporting surroundings inside campus and encouraged students to join creativity competitions and international innovation invention competitions. Although business schools had built channels for their students to do innovation, the portion of students participating in patent activities is not easily increased, especially for business students. This is the reason why we need to understand the relationship between students' motivation and intention to participate patent activities.

There is also no clear consensus about the relative importance of extrinsic incentives and intrinsic interest or about the extent to which students can transform knowledge into practice. To clarify these issues, we concentrated on two motivations—growth need strength (Cerasoli, Nicklin, & Ford, 2014; Elias, 2009; Shally, Gilson, & Blum, 2009) and perceived benefits of innovation (Al-Emadi, & Marquardt, 2007; Petrides, & Frederickson, 2011)—and integrated these into a TPB model to explain business students' intentions to participate in patent activities. Although Goepel, Hölzle, and Knyphausen-Aufseß (2012) proposed a framework of antecedents of individuals' innovation response behaviour, they did not empirically test it in their research, resulting in better understanding in on the relationship between individual innovativeness and intention to participate. Therefore, we used the TPB to examine students' intentions to participate in patent activities after they had completed relevant courses (Souitaris, Zerbinati, & Al-Laham, 2007).

From the perspectives of students' internal psychological state, it is emphasized the desire to practice what was learned during the learning stage of the formal curriculum and may enhance confidence and the need for achievement. Our study discussed the three following issues: 1) the facilitating factors that influence business students' intentions to engage in patent activities; 2) motivational factors (e.g., growth need strength and perceived benefits) that act as direct determinants of attitudes, subjective norms, and perception of behavioral control; and 3) the effectiveness of the research proposed model in predicting students' behavioral intentions based on the TPB model.

LITERATURE REVIEW

To understand what enables students to participate in patent activities, it is important to examine the relationship of the growth need strength and the perceived benefits of innovation with the theory of planned behaviour (TPB) as a model. In this study we propose that individuals must be aware of the growth need strength and recognize the perceived benefits of this process to enhance their intention and transform this into action.

The Theory Planned Behaviour Model

This model proposes that intentions are the direct antecedents of behaviour, and intention is hypothesised to be a linear function of perceived behaviour control, attitudes, and subjective norms about the target behaviour (Ajzen, 1991; Cheng, & Chu, 2016; Jiang et al., 2016). Intentions are assumed to be cognitive factors and to indicate how hard people are willing to try or how much effort they are willing to exert to execute a behaviour (Ajzen, 1991; Enkel, & Bader, 2016). This study investigated students' intentions to apply newly acquired knowledge and skills to participate in generating innovation based on the growth need strength and the perceived benefits of innovation.

The theory of planned behaviour has been applied widely in multiple contexts for predicting intentions ranging from willingness to share knowledge, through students' intention to study (Chu, & Chen, 2016; Enkel, & Bader, 2016). Moreover, Chudry, Foxall, and Pallister (2011), working in the field of psychology, showed that TPB could predict people's action choices. Their framework was used in the present study in an attempt to understand the

relationship between intentions towards innovation and antecedent variables (attitudes, subjective norms, and perceived behavioural control) that might foster innovation. There is a clear rationale for applying it to the question of student participation in patent activities.

The attitudinal component reflects an evaluation of an individual's preferences with respect to behaviour (Enkel, & Bader, 2016). Beliefs about achievement may affect attitudes towards behaviour based on positive or negative evaluations of a particular behavioural performance. So, as an individual's attitude becomes more favourable towards a certain behaviour, he/she forms an increasingly positive desire or intention to engage in the behaviour (Bagozzi, 1992; Yu & Yu, 2010). Attitudinal intentions anticipate future actions. Caro, Mazzon, Caemmerer, and Wessling (2011) explored whether the intention to buy via the internet was directly influenced by attitudes and innovative qualities. In other words, students' attitudes toward innovation reflect their positive or negative evaluation of performing patent activities.

The concept of subjective norms refers to the extent of perceived social pressure from family, friends, or school to perform the behaviour under consideration. That is, subjective norms are a function of the belief that important others will support the performance of the behaviour (Ajzen, 1991). Subjective norms are related to students' perceptions of other people's opinions and the expectations of others regarding participation in patent activities in a business school environment.

Perceived behavioural control is an antecedent of attitudes and reflects an underlying cognitive structure. Perceived behavioural control refers to the individual's perception of the ease or difficulty of performing a particular behaviour (Armitage, & Conner, 2001). Ajzen (1991) argued that an individual's beliefs that his or her behaviour is completely under volitional control gives meaning to perceived behavioural control. Depending on the type of behaviour and the nature of the situation, the degree to which intentions predict behaviours is a function of the magnitude of perceived behavioural control, i.e., one's perceived ability to transform behavioural intentions into action. Generally, individuals with high perceived behavioural control tend to persist and are thus characterised as having a strong intention to perform the behaviour under consideration (Enkel, & Bader, 2016; Yu, & Yu, 2010). In the present study, perceived behavioural control reflected business students' sense of control over their ability to carry out patent activities. We assume subjective norms, attitudes, and perceived behavior control are positively related to an individual's intention to engage in innovative activities, and we present this in the following hypothesis:

H1: An individual's subjective norms have a positive influence on intention to participate in innovative activities.

H2: An individual's attitude has a positive influence on the intention to participate in innovative activities.

H3: An individual's perceived behavioural control has a positive influence on intention to participate in innovative activities.

The TPB is adequate for our purpose, i.e., measuring the strength of students' willingness to try to perform patent activities. Cerasoli et al. (2014) suggested that changes in volitional behaviour need to incorporate active operations to overcome the behavioral inertia generated by beliefs. Building on our previous successful research using the TPB, we here addressed the above problems by integrating the TPB model with additional variables to examine their impact. Ajzen (1991) described a model in which it is possible to add important proximal variables. In this present study, we tested the impact of two additional variables, namely the growth need strength and the perceived benefits of innovation, as predictors of the intention to perform patent activities.

Motivational Factors

Recent evidence has shown that it is crucial to extend theory beyond individual beliefs because beliefs are passive evaluations of behaviour (Cerasoli et al., 2014). To address the above problems and achieve theoretical progress, an extended model containing active incentives in the form of motivational factors was applied as the research framework to understand the factors that drive business students' intentions to participate in patent activities. This model is based on previous theoretical and empirical studies (Noe, & Wilk, 1993; Shally et al., 2009; Cerasoli et al., 2014), which emphasized that two individual-level characteristics, i.e., the growth need strength and the perceived benefits of innovation, are key determinants of an employee's interest in participating in patent activities.

Growth need strength

As noted by Shally, Gilson, and Blum (2009), growth need strength is also an important contributor to creative performance. Growth need strength involves persistence and the power to keep going and confront obstacles that arise in the process of innovation. They also like to learn new things and are committed to their work. Growth need strength refers to an individual's beliefs about the achievement of goals.

Individuals make greater effort to engage in behaviours when these behaviours are believed to be more important in achieving goals (Cerasoli et al., 2014). The individual growth need strength is seen in an individual's readiness to react in a changeable world and to be enriched by learning experiences (Lisak, Erez, Sui & Lee, 2016; Tang, 2016). This strength, in turn, may have an impact on the student's attitude towards and intention to participate in innovative activities. The growth need strength refers to the extent to which an individual desires or values the qualities intrinsic to complex creative activities (Cerasoli et al., 2014). It is indicated in their beliefs about the achievement of goals and the strong need for personal challenge, for learning, and for professional development. Individuals with this type of strength will thrive in complex jobs and organic social systems (Gundry et al., 2016). Patent activities are considered as complex jobs and organic systems.

Individuals make a psychological investment in learning that serves as their internal driver towards growth. We propose that the growth need strength is a psychological phenomenon that involves perseverance in an effort to progress (Kwantes, Karam, Kuo, & Towson, 2008). The force behind it derives from intrapsychic desires that are reinforced through action. Studies have shown that persistence and the ability to tackle obstacles are critical (Zacher, Ambiel & Noronha, 2015). Individuals draw on strong beliefs and internal resources to sustain progress in the face of continuous challenges, doubt, and performance pressures (Baard, Rench & Kozlowski, 2014). This stimulates an individual's willingness to participate in patent activities.

This strength is important in initiating creativity. An individual who has a strong need for personal accomplishment, learning, and development is liable to transfer learning into practice in the demanding and intensive process (Shally, & Gilson, 2004; Tang, 2016). Individuals with great strength of this sort are readily characterised as committed to work where they learn new things and are able to engage in independent thought and action. Elias (2009) argued that individuals with growth need strength have particularly positive attitudes and corresponding behavioural intent (Chou, Chen, & Wang, 2012; Shally et al., 2009; Gundry et al., 2016). Individuals with high growth need strength has clear mindset and know the benefits behind the patent activities. Combining these ideas allows us to propose the following hypotheses:

H4: An individual's growth need strength has a positive influence on perceived benefits.

H5: An individual's growth need strength has a positive influence on subjective norms.

H6: An individual's growth need strength has a positive influence on attitudes.

H7: An individual's growth need strength has a positive influence on perceived behavioral control.

Perceived benefits

Personal beliefs and feelings are probably the most cognitively accessible basis for behavioral choices (Chu & Chen, 2016; Jiang, Zhao, Sun, Zhang, Zheng & Qu, 2016). The current study is proposed that an individual must understand their psychological or internal state, be aware of their growth need, and recognize the perceived benefits of this process to enhance their intention and actively participate in patent activities. Moreover, if students can build their innovation ability through education into their daily life and understand their future goal, it is helpful to start their business after graduation.

Perceived benefits are the students' own beliefs about learning outcomes. Perceived benefits can be divided into intrinsic and extrinsic rewards (Cerasoli et al., 2014; Hagger, & Chatzisarantis, 2016; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009). The achievement of these benefits depends on the individual's motivations related to learning, career considerations, and psychosocial factors. Perceived benefits may be transformed from aspirations of growth to needs and can thereby influence development activities (Gundry et al., 2016; Noe, & Wilk, 1993). On an individual level, innovation is largely assumed to have personal benefits. People who see benefit in innovation expect that certain actions will lead to certain desirable outcomes. These expectations may influence their readiness to participate in patent activities (Cerasoli et al., 2014; Hagger & Chatzisarantis, 2016; Petrides & Frederickson, 2011; Vansteenkiste et al., 2009).

In this study, intrinsic and extrinsic rewards were combined with psychosocial factors and seen as perceived benefits, such as personal development, future career prospects, and job-skills improvement. Participating in patent activities benefits students by making them appear clever and creative, providing access to rewards from campaigns at the university, and providing experience with being an entrepreneur and creating new products (Horwitch, & Stohr, 2012). If students recognise the benefits of training, they tend to be more committed and be more willing to participate in certain activities (Al-Emadi, & Marquardt, 2007; Newman, Thanacoody, & Hui, 2011). Therefore, it is reasonable to infer that perceived benefits positively influence an individual's attitude and intention to participate in patent activities at the university (Jiang et al., 2016). If students realise that the skills acquired in

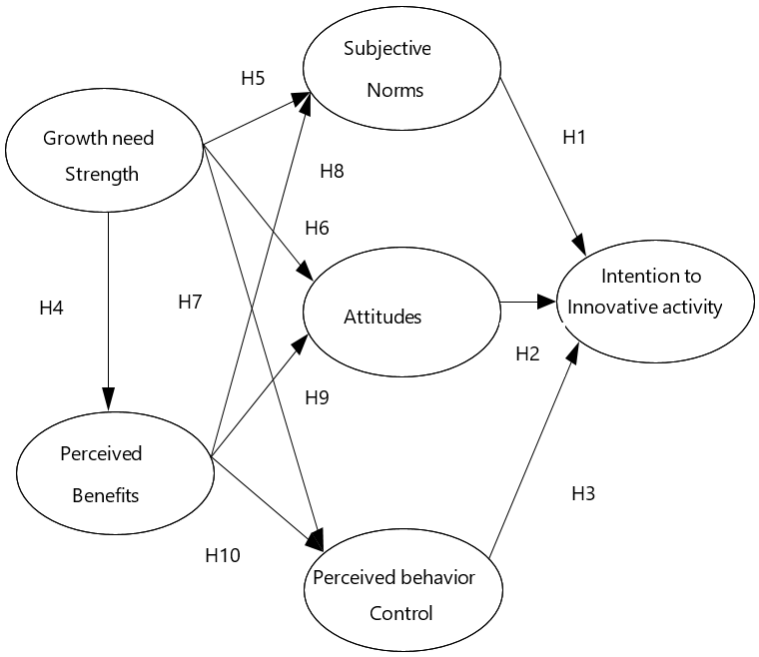


Figure 1. Research model

class can be useful in the future, they are liable to increase their participation in certain activities and expect that this will lead to desirable outcomes. The following hypotheses explain these relationships:

H8: An individual's perceived benefit has a positive influence on subjective norms.

H9: An individual's perceived benefit has a positive influence on attitude.

H10: An individual's perceived benefit has a positive influence on perceived behavioral control.

Extended TPB model

As strength increases, it enhances the orientation towards learning and fosters greater interest in personal growth and the exploration of opportunities for personal development. This depiction is in keeping with the need for achievement and fulfilment, which motivates behaviour towards growth satisfaction via personal fulfilment (Noe, & Wilk, 1993; Tang, 2016). Shally (1995) suggested that specific creative goals foster creativity, resulting in the generation of a greater quantity and higher quality of creative ideas. The goal for growth may drive students to spend more effort in problem solving and in building an assertive attitude that provides more control over the progress of patent activities (Binnewis, & Gromer, 2012). Individuals with a high growth need strength are committed to working, and they expect more benefits or outcomes involving learning new things and engaging in independent thought and action. Perceived benefits are transformed from aspirations to the need for growth and the desire to influence individual development activities (Noe, & Wilk, 1993).

In the TPB model, which Ajzen (1991) described as open to further elaboration, behaviour intention is mediated by three proximal antecedent predictors: attitudes, subjective norms, and perceived behavioral control (Chudry, Foxall, & Pallister, 2011; Chu, & Chen, 2016; Enkel, & Bader, 2016). An extended TPB model was used in the present study as the research framework to understand the factors that drive business student's intentions to participate in patent activities. We compared three extended TPB models in which attitudes, subjective norms, perceived behaviour control, growth need strength and perceived benefits, influenced the intention to engage in innovative activities as follows: (1) Model 1: using simple TPB model to examine behaviour intention; (2) Model 2: growth need strength, perceived benefits and three TPB factors as proximal predictors of behaviour intention; (3) Proposed model: growth need strength influences perceived benefits and both are fully mediated by the three proximal predictors of behavioral intention. The conceptual framework is shown in **Figure 1**.

METHODS

Data Collection

We sampled students from university business schools in Taiwan. The survey targeted undergraduate business students taking creative thinking, innovation management, patent application, and introductory intellectual property rights courses. The student sample was appropriate because university students are an important target market for international invention fairs (Wurthmann, 2014; Wu, & Wu, 2008; Souitaris et al., 2007). Patent activities are difficult to observe from external cues due to the nature of innovation and its complex relation to various activities; however, participants do intentionally choose this behaviour. Furthermore, intention is the best judge as to whether or not patent activities were used. In other words, self-reporting is a fair way to measure actual patent activities. To minimize the possibility of the participants reconstructing history to present a consistent and logical picture, the measurement of intentions was separated from the measurement of other constructs to test the proposed research model. A cover letter included with the survey explained the study and its purpose, which was to identify factors influencing the extent to which students intended to participate in patent activities.

Pretest

Considerable effort was made to ensure that each statement in the formal survey instrument captured the intended meaning of the construct under investigation. Thus a pilot study was conducted before the formal test to fine-tune the wording of the questionnaire and check the psychometric properties. In the pilot test, the questionnaire was given to 48 subjects who had participated in patent activities. The overall reliability of Cronbach's alphas for the factors of each research construct ranged from 0.591 to 0.859, which implied that the scales were appropriate measures of the research constructs. Participation in the study was completely voluntary, and all participants were business school students taking courses on patents, intellectual property rights (IPR), or creative thinking.

Measures

In the formal survey, we received a total of 328 responses. After discarding 24 invalid responses, we had a total of 304 completed surveys from the participants. Of the participants, 43% were male and 57% were female. The questionnaire contained 18 items grouped into six constructs. The survey measured growth need strength, perceived benefits of innovation, attitudes towards innovation, subjective norms, perceived behavioural control, and intentions to apply patent practices. Respondents answered questions related to perceived benefits and growth need strength on a continuum from 0 to 5, representing *strongly disagree* and *strongly agree* respectively (Cheng, & Chiou, 2010; Gundry, et al., 2016). Questions on the TPB model (attitudes, subjective norms, perceived behavioural control, and intentions) were answered using a five-point Likert type scale (ranging from *strongly disagree* to *strongly agree*).

The three items used to assess the perceived benefits that students expected to obtain from patent activities were drawn from Noe and Wilk (1993), Vansteenkiste et al. (2009), and Liñán, Rodríguez-Cohard, and Rueda-Cantuche (2011). Growth need strength was also measured with three items adapted from Shally et al (2009), Enkel and Bader (2016), and Hagger and Chatzisarantis (2016). The questions addressed students think they feel the importance of engaging in a patent activity. The questions that measured attitudes, subjective norms, perceived behavioral control, and intention of TPB model were based on research by Souitaris et al. (2007), van Gelderen et al. (2008), Cheng and Chu (2016), and Chu and Chen (2016).

Common Method Bias

We operationalized the constructs using items from previous studies, which we then translated into Chinese and revised the wording to fit the specific needs of this study. Common method bias is a potential threat to internal validity, particularly for research that uses survey responses in a single setting. According to Harman's one-factor test, the threat of common method bias is high if a single factor can account for the majority of covariance in the independent and dependent variables (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). According to our statistical test result, a principal components factor analysis did not detect a single factor explaining the majority of the covariance, thus common method bias did not exist in the current study.

DATA ANALYSIS

To establish construct validity, we evaluated the convergent and discriminant validity of the structural equation model and the measurement model using AMOS 16.0. Examining the coefficients and their significance, the

Table 1. Cronbach's Alpha, Average Variance Extracted, Composite Reliability, Variance Explained

Constructs	Mean	SD	Cronbach's Alpha	AVE	Composite Reliability
Intention to innovative activities	3.52	0.73	0.847	0.766	0.907
Subjective norm	3.86	0.66	0.752	0.670	0.859
Perceived behavioural control	3.64	0.70	0.713	0.648	0.842
Attitude	3.52	0.67	0.746	0.665	0.856
Growth need strength	4.53	0.82	0.876	0.803	0.924
Perceived benefits	4.09	0.84	0.723	0.643	0.844

Table 2. Inter-factor Correlation Matrix

	1	2	3	4	5	6
1 Intention to innovative activities	0.875					
2 Subjective norm	0.646**	0.819				
3 Perceived behavioural control	0.597**	0.541**	0.805			
4 Attitude	0.667**	0.645**	0.617**	0.815		
5 Growth need strength	0.353**	0.308**	0.307**	0.301**	0.896	
6 Perceived benefits	0.351**	0.302**	0.338**	0.307**	0.568**	0.802

** $p < .01$

The diagonal elements are square roots of average variance extracted (AVE) from observed variables; off-diagonal elements are correlations between constructs.

variance of the endogenous constructs provides important information about the predictive power of the model. Fornell and Larcker (1981) suggested the use of the average variance extracted (AVE) and the construct reliability (CR) to examine convergent and discriminant validity. Questionnaire items were identified using confirmatory factor analysis. Discriminant validity can be used to measure the extent to which constructs differ and is considered adequate when the square root of the AVE for a certain construct is greater than the correlation estimates between that construct and other constructs. Construct validity requires that individual standardized factor loadings (regression weights) of reflective constructs be at least 0.5–0.55 and preferably reach 0.7 (Hair, Black, Babin, & Anderson, 2010).

Additionally, as pointed out by Chin (1998), and Barclay, Higgins and Thompson (1995), loadings of at least 0.5 may be acceptable if loadings of other items in the same construct exhibit high reliability scores. As a general guideline, adequate convergence at the construct level requires AVE >0.5 and CR >0.7. Confirmatory factor analyses were performed to assess the validity of the measurement models. Models that fit the data well are considered excellent according to the following four indices: Tucker Lewis Index (TLI >0.9), comparative fit index (CFI >0.9), root mean square error of approximation (RMSEA <0.08), and standardized root mean square residual (SRMR <0.08) (Hair, Black, Babin & Anderson, 2010; Ning, & Downing, 2012).

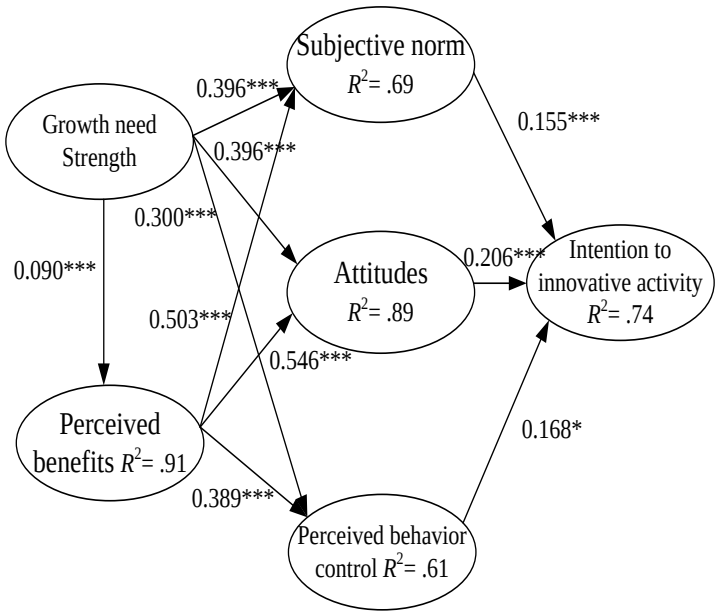
Test of the Measurement Model

Survey descriptive statistics (mean, standard deviation, inter-correlation) are shown in **Tables 1** and **2**. Results indicate that all scales had high reliability (Cronbach's alpha ranging from 0.713 to 0.876), and the bivariate correlations between all measured variables exhibited the expected positive direction. The values of the diagonal elements (square roots of the AVE) exceeded the off-diagonal elements (correlation coefficients), indicating that each construct shared more variance with related items than it did with other constructs. All constructs had significant parameter estimates, with standardised estimates >.05, AVE values > 0.6, and CR values >0.8. All constructs exceeded the minimum acceptable value of 0.5.

Confirmatory factor analysis showed that six factors with 18 items describing the intention to participate in innovative activities had satisfactory fit statistics (χ^2 [168] = 281.4, TLI = 0.961, CFI = 0.970, RMSEA = 0.047, SRMR =0 .0494). These results also suggest that the data reflect satisfactory convergent validity for each subscale.

Research Model Testing

The appropriateness of a theoretical model is established by the strength of each structural path and the combined predictiveness (R^2) of its exogenous constructs (Chin, 1998). Falk and Miller (1992) suggested that the variance in endogenous variables explained by R^2s should be greater than 0.1. **Figure 2** also shows the explained variance for each of the constructs in the model. To test the fit of the structural model, we examined the statistical significance of the path coefficients from one latent variable to another. As shown in **Table 3**, the overall goodness of fit was satisfactory for the research model (χ^2 [125] = 268.56, TLI =0 .933, CFI = 0.945, RMSEA =0.062, SRMR =0.057, and AIC=360.56).



* p < .1; ** p < .05; *** p < .01

Figure 2. The path coefficients of the research model

Table 3. Fit statistics for competing models

Fit indices	Research model	Simple TPB	TPB with Growth need strength and perceived benefits
χ^2	268.56	449.495	666.519
df	125	62	130
TLI	0.933	0.752	0.760
CFI	0.945	0.803	0.796
RMSEA	0.062	0.144	0.117
SRMR	0.057	0.264	0.253
AIC	360.560	507.495	748.519
R^2	0.740	0.576	0.579

As shown in the research model in **Figure 2**, nine of ten paths were statistically significant at the .001 level, and one at the 0.1 level (path of perceived behavioural control to intention). Furthermore, the R^2 values of the perceived benefits, subjective norms, attitudes, perceived behavioural control, and intention were 0.91, 0.69, 0.89, 0.61, and 0.74, respectively, for our research model. We compared alternative models to select the better model. The Akaike's information criterion (AIC), which is appropriate for comparisons between the research model and the simple TPB model (Tabachnick, & Fidell, 1999), was used to select the best model. As lower AIC values indicate a better fit, the research model that had the smallest AIC value among the two TPB models was shown to provide the best fit, making it superior to the other models.

Mediation effect

We also assess whether subjective norm, attitudes and perceived behavior control mediates the relationship between growth need strength and perceived benefits and intentions to patent activities (Preacher, & Hayes, 2008). Using a serial SPSS procedure for estimating direct and indirect effects, the result shows that three direct effect and two indirect effects are significant. In the first mediator test, the three direct effects of subjective norm, attitudes, perceived behavior control have significant impacts on the relationship of growth need strength and intention. Moreover, a large or the completely indirect effect of the mediator affecting the direct effect was shown on subjective norm and perceived behavior control. The indirect effect of attitudes as mediator was insignificant (see **Appendix A**). The result finds support as subjective norm, attitudes and perceived behavior control fully and partially mediates the relationship between growth need strength and intention to patent activities. In second

mediator test, the result (see **Appendix B**) also finds support as subjective norm, attitudes and perceived behavior control fully and partially mediates the relationship between perceived benefits and intention to patent activities.

RESULTS

In this study, the extended TPB model was examined to select the best model that identified the relationship among factors influencing business students' intentions to participate in patent activities. As shown in **Table 3**, our research model met the overall goodness-of-fit criteria. The research model had greater predicative power at 74%, while the two simple TPB models only achieved 57.6% and 57.9% explained variance.

Moreover, the model fit well with the combination of growth need strength and perceived benefit to extend the TPB model. The result was consistent with that of Enkel and Bader (2016); the extended TPB model had higher explanatory power. The extended TPB research model's R^2 value of intention accounted for 74% of the explained variance. This model appears superior for assessing intention to participate in patent activities. The R^2 values of attitudes, subjective norms, and perceived behavioural control were 0.89, 0.69, 0.61, respectively. From the analysis, the explained variance of the extended TPB model was higher than previous research, which was between 21%~49% (Enkel, & Bader, 2016; Krueger, Reilly, & Carsrud, 2000; Schlaegel, & Koenig, 2014) and also higher than the 16.4% compared to the simple TPB model. This may indicate the importance of the antecedent variables of growth need strength and perceived benefits in our research.

In the research model, the three path coefficients presenting the most influential antecedents of intention to participate in patent activities were $\beta = 0.206$, $\beta = 0.155$, $\beta = 0.168$ and $t = 3.827$, $t = 3.190$, and $t = 1.686$, respectively. The results indicate that students' attitudes had the strongest effect on their intention to participate in patent activities. The results were consistent with previous studies (Enkel, & Bader, 2016; Gundry et al., 2016; Wu, & Wu, 2008). Attitudes indicate that members were better participants in patent activities than other members who were more likely to spend efforts on patent activities. Additionally, family, classmates, friends, and the university had positive impacts on students' intentions to participate in patent activities. Subjective norms were the weakest predictor of intention (Fayolle, & Liñán, 2014). A weak relationship was found between perceived behavioural control and the intention to enact patent activities. The path from perceived behavioural control to intention was statistically significant at $p = 0.092$. In this study, perceived behavioural control was a medium predictor of intention to participate in patent activities, which differs from previous findings showing perceived behavioural control to be a strong predictor (Plant, & Ren, 2010; Schlaegel, & Koenig, 2014). This can be explained by institutional differences. In most universities in Taiwan, they promote such activities and encourage their students to participate in some form of patent activity; however, students appear not to be keen on applying for patents.

The extent of students' attitudes emerged from their growth need strength and perceived benefits. This is based on their expectancies concerning whether the behaviour will result in particular desirable outcomes, and they think it is worthy and beneficial. Growth need strength indicates employees' internal expectations and desires for what they will obtain from their work. Employees with higher growth need strength tend to value personal development and feedback, and thus enjoy more creating and challenging work (Gundry et al., 2016; Shally et al., 2009; Schlaegel & Koenig, 2014; Souitaris et al., 2007). People scoring high on growth need strength might be constantly searching for new challenges and should respond eagerly to the opportunities provided by enriched work. Growth need strength seems more likely to be related with intrinsic work motivation. They are predicted to develop strong internal motivation when working on complex, challenging jobs (Cerasoli et al., 2014). The innovation activities of patent applications are like kinds of complex, challenging tasks. The concept of growth need strength is crucial to the theory of work motivation underlying the job context. Individuals should assess individual needs for growth opportunity contingent upon their growth need strength, which has both a positive effect on creativity and an intention to innovation. Students performing creativity requires some stimulating force as growth need strength that drives individuals to push themselves and assist in the face of challenges, inconsistent innovation, and performance pressures (Gundry et al., 2016; Shalley et al., 2009).

Individuals may perceive benefits result from activities before they will participate. Noe and Wilk (1993) also had similar findings that perception of benefits exerts a significant effect on participation in training activities; students' based their expectations on the benefits they gain from participation in courses. Therefore, the understanding of the anticipated benefits participants seek through their involvement in patent applications may have the potential to offer professors or mentors suggestions, thus nourishing the emergence of more interest in business schools (Wurthmann, 2014; Souitaris et al., 2007).

DISCUSSION

The present study used the theory of planned behaviour (TPB) to determine the effects of following a curriculum on students' intentions to participate in patent activities. In terms of the hypotheses posed at the beginning of this study, it is now appropriate to state that growth need strength and perceived benefits worked in combination of TPB model predicted participation intentions with respect to patent activities. This supports existing research demonstrating a relationship between measures of intrinsic motivation and planned of patent participation behaviour intention (Enkel, & Bader, 2016). We also found a relationship among student learning, cognitions, and intentions. Growth need strength, perceived benefits, attitudes, subjective norms, and perceived behavioural control positively affected intentions toward participation in innovation activities and the appropriateness of the expanded TPB model addressed on psychological cognition. It also has educational implication on building and nurture higher psychological needs (Chu, & Chen, 2016; Lisak et al., 2016). It is likely to say that our sample was focus on business school students. Most innovation courses in business school are compulsory and the willingness of business students' to participate patent activities is limited by course arrangement. It may not arouse from their aggressiveness. Thus, growth need strength is the transformer and become a strong and powerful force to stimulate students' psychological needs. The current findings contribute substantially to our understanding of the development of knowledge to creativity among business students with regard to patent activities.

The extended TPB model combination with growth need strength and perceived benefits is increased much more explanatory power than simple TPB model, and also has better overall goodness of fit (Cheng, & Chu, 2016; Chu, & Chen, 2016). The findings suggest that growth need strength and the perceived benefits of innovation are powerful motivators for persuading students to participate in patent activities. Moreover, student attitudes, subjective norms, and perceived behavioural control are important factors between student growth and innovation practices. The research model is more applicable than the simple TPB model for developing learning strategies to motivate and enhance students' intentions to participate in patent activities. These results suggest that universities in general and specifically in Taiwan must recognize the need to inspire student growth and to value the expected outcomes of patent practices.

The intentions of business students to participate in innovation activities was explored in this study and the results showed that personal growth need strength and perceived benefits have an indirect influence to their participating intention by TPB model. To enhance the robustness of research model, ten engineering students were complement to our sample as focus group interview and they were asked to explain 5 factors of motivation for them to participate patent activities. After one hour interview, the major reasons for patent activities are synthesized into our research motivation as perceived benefits (23 times of 50) and personal growth need strength (13 times of 50), and followed motivations by individual attitude and subjective norm in university environment (both are 6 times of 50). Similarly, Genco, Holtta-Otto, and Seepersad (2012) pointed out that creativity is one part of the engineering design course, but engineering students do not need to become more innovative through the course training based on their research experiments. Therefore, the main driving force in patent activity could be concluded by internal belief, such as personal growth need strength, perceived benefits or self-efficacy both for business and engineering students.

Implications for Theory and Practice

The findings point to several implications. First, growth need strength underlies students' perception of the benefits of innovation, their attitudes toward innovation, subjective norms regarding such activities, and perceived behavioural control, all of which support the intention to participate in patent activities. These, and other vital issues regarding the effects of growth need strength, remain largely open for future research to explore and explain. These factors foster students' desire for personal challenge and professional development through learning. They form a powerful driving force that originates from students' internal desires, which are then reinforced by converting intention into action. Educators in business schools may encourage students by enhancing the strength of their growth need. This may be followed by building confidence, maintaining an open environment, respecting independent thought and action, and facilitating satisfaction with personal growth.

Second, perceived benefits drive student intentions towards patent activities. If students have more confidence and greater readiness to respond in complex and challenging situations, they will believe that they can secure the desired outcomes and meet their expectations in the future. This is consistent with Petrides and Frederickson's (2011) research, the demand side of the individual's achievement, which found that students were more willing to commit to their efforts. Lecturers should explain the advantages of taking part in patent activities for personal development and for their future career opportunities. These data also suggest that educators in business schools devote more time to explaining and communicating with students about the advantages of participating in patent activities in university settings. Indeed, the benefits of student participation in patent activities are not limited to individual growth. Such benefits can relate to career development insofar as they can assist in securing a job,

obtaining salary increases, and achieving personal success at work. The results of this study can help educators draw on students' experiences and cognitions to improve their willingness to participate in patent activities. To promote patent applying, educators must increasingly perform activities that are more valued, so feeling beneficial in activities becomes important.

Finally, attitude is the most influential factor contributing to students' intention to participate patent activities, and subjective norm, attitudes and perceived behaviour control also serve as important mediators of the relationship between individual needs and the intention to patent activities. When students have a strong need for growth and believe they will obtain the expected positive outcome, their attitudes towards these practices become more favourable, and to effectively increase students' patent applying intention. Therefore, universities should guide student preferences with respect to positive patent activities. Student attitudes are important variables in transforming intentions into actions.

Another lesson needs to be addressed on core value of general higher education. University students are expected infusing into workforce and starting their job career in nearly future. If we can understand how motivate the creativity to social freshman, it will contribute to firm's development. However, innovation is the major sources of competitive advantage for firms and also important to entrepreneurship. Innovation should be motivated all employees' creativity from each level and each division rather than limited on certain fields or in engineering school (Cerasoli et al., 2014). Similar to Jabade et al. (2008)'s opinions, business students cannot be excluded from innovation contribution force. Innovation is always market driven and consumer orientation. This study suggests entrepreneur team has cross-discipline members (especially business students) to avoid their risk of new product failure into market. The reason is to reduce the possibility of new product unsatisfied with customer needs.

Limitations, and Future Directions

The findings of this study have several limitations. As our results were obtained from business students in Taiwan, the extent the findings apply to students in other subjects and other countries is unclear. Patent activities are somehow comprehensive work to business students. When participation behavior was predicted by empirical research, it may consider the job characteristics and work context on creativity activities. Autonomy and course feedback may influence students' attitudes to patent activity involvement. Another limitation is that this study focused on behavioral intention, not behavioral performance, although the TPB model indicates that intention can be a proxy for behaviour. Perhaps future research on motivational factors related to growth need strength and perceived benefits of performing innovative activities should consider implementation of innovation as well. The current study only examined innovation in terms of patent activities; however, commercialization is also very important to patent activities, and this study was not designed to evaluate factors related to this domain. Patents and commercialization are two aspects of the practical skills related to product or service development. In consideration of lower rate of participation to patent application for business students, this study focused on investigating the motivation of patent activity of business students, however, this is also the limitation of this study. The association between the education provided by business schools and commercialization skills should be investigated in future studies. Future research on the role of growth need strength would be of great help in facilitating innovation and providing practical suggestions for business students.

CONCLUSIONS

Without doubt, the range and variety of advances in theory of planned behaviour model and student's patent applying research described in this study has significantly advanced our understanding of how these phenomena play out at the research model. Our objective in undertaking this study found that growth need strength and perceived benefits of innovation are antecedent predictors of students' behavioral intention to perform patent activities. Our findings suggest that attitudes, subjective norms, and perceived behavioral control act as mediators in the relationship between growth need strength and perceived benefits with the intention to perform patent activities. The predictive power of the proposed full model was superior to simple TPB model. The results also indicated that students' attitudes had a stronger effect on their intention to participate patent activities than did subjective norms and perceived behavioral control. Our findings are only a first step because the simplest models of patent applying behaviour intention primarily consider why, rather than whether, one is motivated. To encourage students to participate in patent activities in universities, it is crucial for educators in business schools to enhance students' need for growth. These findings also suggest that business educators should communicate to students the advantages of participating in patent activities in a university setting. Benefits obtained from student participation in patent activities extend beyond individuals' growth to their future careers.

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APPENDIX A

The First Example Mediator Test Results

IV= growth need strength; DV= Intention to innovative activities						
	product of coefficients				Percentile 95% CI	
direct effect	Point estimate	SE	*t*	*p*	Lower	Upper
constant	-0.136	0.202	-0.671	0.503	-0.534	0.263
PB->INT	0.065	0.051	1.277	0.203	-0.035	0.165
SN->INT	0.283**	0.060	4.735	0.000	0.165	0.401
PBC->INT	0.199**	0.052	3.846	0.000	0.097	0.301
ATT->INT	0.367**	0.058	6.356	0.000	0.254	0.481
GNS->INT	0.060	0.055	1.081	0.281	-0.049	0.168
	product of coefficients				Percentile 95% CI	
indirect effect	Point estimate	SE	*t*	*p*	Lower	Upper
Total:	0.344**	0.064	5.375	0.000	0.213	0.464
Ind1:GNS->PB->SN->INT	0.015	0.017	0.882	0.189	-0.015	0.052
Ind2:GNS->PB->PBC->INT	0.007	0.014	0.500	0.309	-0.015	0.042
Ind3:GNS->PB->ATT->INT	0.005	0.019	0.263	0.396	-0.031	0.044
Ind4:GNS->SN->INT	0.073**	0.029	2.517	0.006	0.024	0.133
Ind5:GNS->PBC->INT	0.033*	0.020	1.650	0.049	0.000	0.078
Ind6:GNS->ATT->INT	0.022	0.028	0.786	0.216	-0.035	0.079

GNS: growth need strength; PB: perceived benefits; SN: subjective norm; ATT: attitude; PBC: perceived behavioural control; INT: Intention to innovative activities;

APPENDIX B

The Second Example Mediator Test Results

IV= perceived benefits; DV= Intention to innovative activities						
	product of coefficients				Percentile 95% CI	
direct effect	Point estimate	SE	*t*	*p*	Lower	Upper
constant	-0.093	0.199	-0.467	0.641	-0.483	0.298
SN->INT	0.288**	0.060	4.827	0.000	0.170	0.405
PBC->INT	0.205**	0.052	3.971	0.000	0.103	0.307
ATT->INT	0.371**	0.058	6.425	0.000	0.257	0.485
PB->INT	0.104**	0.035	2.941	0.004	0.034	0.174
	product of coefficients				Percentile 95% CI	
direct effect	Point estimate	SE	*t*	*p*	Lower	Upper
Total:	0.250**	0.040	6.250	0.000	0.172	0.329
Ind1:PB->SN->INT	0.077**	0.026	2.962	0.002	0.033	0.132
Ind2:PB->PBC->INT	0.034*	0.019	1.789	0.037	0.006	0.077
Ind3:PB->ATT->INT	0.022	0.018	1.222	0.111	-0.011	0.058

PB: perceived benefits; SN: subjective norm; ATT: attitude; PBC: perceived behavioural control; INT: Intention to innovative

APPENDIX C

Item Wordings and Loadings

Construct	Items	Factor Loadings
Growth need strength (GNS)	It is important for you to engage in an innovative activity because of having an opportunity to think independently.	0.715
	It is important for you to engage in an innovative activity because of having an opportunity to learn new things	0.906
	It is important for you to engage in an innovative activity because of stimulating individual growth and development	0.907
Perceived benefits (PB)	Participation in innovative activities will help improve my performance at the university	0.660
	Participation in innovative activities will help me increase my salary after graduation	0.649
	Participation in innovative activities will help me improve my skills	0.742
Subjective norms (SN)	I believe my parents agree with me about making a patent application.	0.593
	I am willing to make a patent application, and my teacher encourages me to do so.	0.761
	When I know that many classmates are writing and filing patent applications, I will also be willing to do so.	0.807
Perceived behavioural control (PBC)	It will be easy to find someone who will help me solve problems when I choose to innovate and apply for a patent.	0.400
	I believe I would be able to exert a lot of effort towards a patent application.	0.924
	I believe it is worth exerting a lot of effort towards a patent application.	0.796
Attitude (ATT)	I think it is a great idea for our university to encourage students to make patent applications.	0.589
	To me, learning about innovative activities (e.g. patent application) is interesting and exciting.	0.727
	I like to participate in innovative activities.	0.815
Intention (INT)	I am willing to go ahead with a patent application.	0.829
	I intend to attend more courses on intellectual property in the future.	0.771
	I am willing to go ahead with a patent application even if the university does not ask me to do so.	0.822