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The Effect of the Application of Multimedia on Technology Innovation and Entrepreneurial Competitiveness

Li LAN[1], Cheng-Wen LEE[2], Hao-Yuan YU[3]

Abstract

Going through the operation in past years, high-tech industry has formally acquired positive affirmation. The basic character of high-tech industry shows technology-intensive and capital-intensive high-risk and high-profit industrial characteristics based on innovative competition. Since the maturity of the Internet, the entire education environment is largely changed and expanded to comprehensive and diverse computer multimedia networks. The application of multimedia to innovation education therefore becomes the new core of business management in technology industry. Aiming at employees of high-tech industry in Fujian Province, total 450 copies of questionnaire are distributed in this study, and 341 valid copies are retrieved, with the retrieval rate 76%. The research results show positive relations between 1.innovation education and technology innovation, 2.technology innovation and entrepreneurial competitiveness, and 3.innovation education and entrepreneurial competitiveness. At the end, suggestions are proposed according to the results, expecting to assist high-tech organizations in promoting technology innovation and entrepreneurial competitiveness through innovation education.

Keywords: multimedia, innovation education, technology innovation, entrepreneurial competitiveness, social welfare.

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Introduction

Along with governmental policies and the establishment of science parks, high-tech organizations, after the operation in past years, have formally acquired positive affirmation. Transforming and upgrading from traditional industries to the reform of industrial operation, the elements of industrial reform and the success fruit are gradually implanted to emerging industries with the introduction of high technology and high added value, under the promotion of policies. There is failure in the experiences; however, it is the essential process for a healthy industrial structure and competitiveness as well as an important course for the value of new-generation business management and the understanding of the emergence and the access to the leading status of an industry. High-tech industry presents the basic character of technology-intensive and capital-intensive high-risk and high profit industrial characteristics based on innovative competition. Such industrial operation has to seek for changes and upgrading in traditional management models. Innovation education therefore becomes the new core of business management in high-tech industry.

Since the maturity of the Internet, the entire education environment is largely changed, and knowledge sources are expanded from books, teachers, and schools to comprehensive and diverse computer multimedia networks. Computer multimedia assisted teaching contains texts, graphs, images, and music as well as delicate arrangement and vivid interpretation to thoroughly break through the entire teaching activity. For this reason, the utilization of computer multimedia assisted materials as teaching materials for innovation education is appropriate. Under the premise of integrating technology & information and computer multimedia into subject teaching, it would become the edge to lead the new-generation teaching under the impact of technology trend in the 21st century. Based on innovation education, the effect of the application of multimedia on technology innovation and entrepreneurial competitiveness is therefore discussed in this study, expecting to help high-tech organizations promote technology innovation and entrepreneurial competitiveness through innovation education.

Literature review

Innovation education

Chao *et al.* (2016) regarded innovation education as the value-oriented education based on the cultivation of people's innovation spirit and innovation ability. Mugge *et al.* (2017) mentioned that innovation education did not aim to pursue the inculcation and upgrading of traditional education and continuing education, but to result in detonation to release humans' potentials and to stress on the combination of potential development with the cultivation of people's excellent psychological

quality and positive attitudes towards life. Baskarada & Watson (2017) pointed out innovation quality as the concern of innovation education; such quality presented dominance and maximal age appropriateness in current and future quality of talents. Persaud *et al.* (2017) explained the implementation of innovation goal as the cultivation of innovation talents that it was not the cultivation in certain stage of education, but the relay effect formed by the education in various stages. Hill *et al.* (2016) regarded innovation education as integrated education and the education ideology, education philosophy, and education practice implemented in people's lifelong education process.

Referring to Zhang *et al.* (2017), three dimensions are applied to innovation education in this study: (1) *Moral management*: Work performance is the main factor in personnel being encourage; (2) *Goal management:* Goal management is the management philosophy and management technique to self-set the important work objectives, self-control the schedule, and self-evaluate the performance through upper/lower supervisor meetings to offer employees with satisfaction after the completion of tasks; (3) *Interface management:* Effective interface control among research & development, production, and marketing could improve the R&D quality and speed of new products.

Technology innovation

Chen *et al.* (2016) referred corporate technology innovation as introducing or changing the function characteristics or technology standards of products or processes. Beglaryan *et al.* (2017) further divided corporate technology innovation into product innovation and process innovation. Product innovation referred to an enterprise developing or introducing new products or service; and, process innovation referred to changing the methods of product manufacturing or service provision. Sumak *et al.* (2017) stated that the objective of product innovation was to improve or develop new products in order to respond to customer needs for new products or grasp new markets. Product innovation based on new technology or the integration of existing technologies could create new products for the market. Hwang *et al.* (2017) mentioned that an enterprise preceding product innovation to satisfy customer or market needs aimed to keep the competitive advantage in the market. New manufacturing materials, hardware facilities, or software systems might be introduced into the product and service generation process in process innovation. In the study on the technology innovation patterns of small and medium enterprises in Europe and America, Nikou & Economides (2017) classified technology innovation into product or process, continuity or discontinuity, and radicalization or progress. Each type of technology innovation was correlated with the manufacturing of new products or the improvement of products.

Referring to Hong *et al.* (2017), the following dimensions are used for technology innovation in this study: *Product innovation*: A product innovation scale evaluates

the capability of a company developing new products or significantly improving products; (2) *Process innovation*: A process innovation scale evaluates the capability of a company developing new or changing production and technology processes.

Entrepreneurial competitiveness

Feng *et al.* (2016) regarded the focus of entrepreneurial competitiveness on industry productivity, technology innovation ability, and industry life cycle. Yuan *et al.* (2016) stated that an industry was composed of enterprises existing in a country; the factors in entrepreneurial competitiveness of an industry therefore contained factors of enterprises, industries, and country. Chun *et al.* (2016) pointed out entrepreneurial competitiveness of a country as the creation of good business environment in the competition process between a country's industry and the innovation industry of other countries, allowing the country, industry, and enterprises acquiring competitive advantage in the corporate innovation industry. Obeidat *et al.* (2017) mentioned that economic growth and the promotion of overall social welfare were generally emphasized when discussing national competitiveness. Kabra *et al.* (2017) concluded that entrepreneurial competitiveness of an enterprise referred to an enterprise, under competitive markets, acquiring external resources through the cultivation of the resources and capability for the utilization to create value for customers, implement the value, and make profits.

Referring to Li *et al.* (2017), the following dimensions are applied to measure enterprise competitiveness in this study: (1) *Competition potential*: cost competitiveness, productivity, price competitiveness, and technical indicator; (2) *Management process*: involvement degree in entrepreneurship; (3) *Competition performance*: export market share, trade surplus, export growth rate, and profitability.

Research hypothesis

Chen & Fiore (2017) proposed the close relationship between organizational management innovation and corporate technology innovation. Zheng *et al.* (2016) found out positive effects of the combination of technology innovation (product and process) and non-technology innovation (organization and marketing) on organizational profit-making. Garaus *et al.* (2016) included product innovation and process innovation in corporate technology innovation; product innovation could have enterprises keep differential advantage from competitors, while process innovation allowed enterprises achieving cost advantage. Zhang *et al.* (2017) indicated that an enterprise introducing such two types of innovation through innovation education could enhance new income and promote the cost effectiveness to acquire market competitive advantage, and organizational innovation education was the direct source of competitive advantage. Karimi (2016) pointed out organizational innovation education as an important tool to help an enterprise

plan and promote the advantage, profitability, and performance. Accordingly, the following hypothesis is inferred.

H1: Innovation education reveals significantly positive relations with technology innovation.

Lee *et al.* (2017) considered organization innovation as the root of organizational performance, meaning that organization innovation was the combination of technology innovation capability or knowledge capability, rather than the powerful function of products, was flexible, presented the function of adjustment or evolution, and was a unique resource in the value chain as well as the key success factor and basis of long-term sustainable development of an organization. To cope with environmental changes, an organization therefore should precede constant technology innovation to develop core competitiveness and promote entrepreneurial competitiveness (Chen *et al.*, 2016). Girod *et al.* (2017) studied the internal strength of an enterprise and the selection of strategies. An enterprise preceding technology innovation aimed to provide better products or service than the competitors to enhance the profitability and maintain the better organizational entrepreneurial competitiveness. Hong *et al.* (2017) considered that an enterprise could precede various combinations with the resources and technologies to generate distinct technology innovation and guide the enterprise to acquire, develop, and apply technology innovation in order to execute the entrepreneurial strategy and promote the entrepreneurial competitiveness of the company. From above literatures, the following hypothesis is inferred in this study.

H2: Technology innovation shows remarkably positive relations with entrepreneurial competitiveness.

Yu *et al.* (2017) indicated that the application of innovation education allowed the technology innovation of an enterprise; and, technology innovation contained product innovation and process innovation. Product innovation allowed enterprises and the competitors keeping the differential advantage, and process innovation allowed an enterprise achieving cost advantage. Both benefited entrepreneurial innovation and entrepreneurial competitiveness. Hansen *et al.* (2019) mentioned that organizational vision and strategy were the most important part in the promotion of organizational performance in an industry. Innovation education stressed the most on the establishment of vision and strategies to cultivate innovation ability in order to acquire the entrepreneurial competitiveness in the industry by constant R&D of innovation products. Li *et al.* (2017) indicated that an enterprise promoted the innovation ability by the introduction of innovation education could enhance the income of new business, promote the cost effectiveness, and acquire the competitive advantage of new entrepreneurial market. Lussier & Hartmann (2017) considered that the operation of innovation education would determine

the entrepreneurial competitiveness of an organization to generate competitive advantage for the organization. According to above literatures, the following hypothesis is inferred.

H3: Innovation education appears notably positive relations with entrepreneurial competitiveness.

Sample and measurement index

Research sample and object

Aiming at employees of high-tech industry in Fujian Province, total 450 copies of questionnaire are distributed, and 341 copies are retrieved, with the retrieval rate 76%.

Reliability and validity test

Validity refers to a measurement tool being able to really measure what a researcher intends to measure. Validity is generally divided into content validity, criterion-related validity, and construct validity. The questionnaire items in this study are referred to domestic and international researchers that the questionnaire shows certain content validity. Dimensions of innovation education, technology innovation, and entrepreneurial competitiveness in this study are preceded the overall structural causal relationship test with linear structural relations model, and the data input is based on the correlation coefficient matrix of above observed variables. The linear structural relations model analysis results reveal the overall model fit reaching the reasonable range that it presents favorable convergent validity and predictive validity. Item-to-total correlation coefficients are also utilized for testing the construct validity of the questionnaire content in this study, i.e. reliability analysis. The calculated item-to-total correlation coefficients are used for judging the questionnaire content. The item-to-total correlation coefficients of the dimensions in this study are higher than 0.7, revealing certain degree of construct validity of the questionnaire.

To further understand the reliability and validity of the questionnaire, reliability and validity are analyzed in this study. The higher Cronbach's α shows the better reliability. According to the standards to develop the formal questionnaire, the measured Cronbach's α appears in 0.75~0.90, apparently conforming to the reliability range.

Results

LISREL model evaluation index

LISREL (linear structural relation) model combines factor analysis and path analysis in traditional statistics and adds simultaneous equations in econometrics to simultaneously calculate multiple factors and multiple causal paths. The evaluation of model fit could be evaluated from preliminary fit criteria, overall model fit, and fit of internal structure of model.

The research data are organized in *Table 1*. The preliminary fit criteria, internal fit, and overall fit are further explained as followings. From *Table 1*, three dimensions of innovation education (morale management, goal management, interface management) could significantly explain innovation education ($t>1.96$, $p<0.05$), two dimensions of technology innovation (product innovation, process innovation) could remarkably explain technology innovation ($t>1.96$, $p<0.05$), and three dimensions of entrepreneurial competitiveness (competition potential, management process, competition performance) could notably explain entrepreneurial competitiveness ($t>1.96$, $p<0.05$). Apparently, the overall model in this study shows favorable preliminary fit criteria.

In terms of internal fit, innovation education reveals positive and significant correlations with technology innovation (0.866, $p <0.01$), technology innovation appears positive and significant correlations with entrepreneurial competitiveness (0.857, $p <0.01$), and innovation education presents positive and remarkable correlations with entrepreneurial competitiveness (0.823, $p <0.01$). H1, H2, and H3 are supported.

In regard to overall fit, the overall model fit standards $\chi 2/Df=1.162$, smaller than the standard 3, and RMR=0.006 reveal proper results of $\chi 2/DF$ and RMR. Moreover, chi-square is sensitive to sample size that it is not suitable for directly judging the fit. Nevertheless, the overall model fit standards GFI=0.968 and AGFI=0.902 achieve the standard 0.9 (the closer GFI and AGFI to 1 showing the better model fit). Accordingly, this model presents favorable goodness-of-fit indices.

Table 1: Overall linear structural model analysis result

Evaluation item	parameter/evaluation standard		result	t
preliminary fit	innovation education	morale management	0.704	9.65**
		goal management	0.725	10.94**
		interface management	0.716	10.21**
	technology innovation	product innovation	0.683	8.44**
		process innovation	0.697	9.23**
	entrepreneurial competitiveness	competition potential	0.746	12.58**
		management process	0.733	11.75**
		competition performance	0.751	13.49**
internal fit	innovation education→technology innovation		0.866	33.75**
	technology innovation→entrepreneurial competitiveness		0.857	29.91**
	innovation education→entrepreneurial competitiveness		0.823	25.32**
overall fit	X2/Df		1.162	
	GFI		0.968	
	AGFI		0.902	
	RMR		0.006	

*Note: * stands for p<0.05, ** for p<0.01, and *** for p<0.001.*

Table 2: Hypothesis test

research hypothesis	correlation	empirical result	P	result
H1	+	0.866	P<0.01	supported
H2	+	0.857	P<0.01	supported
H3	+	0.823	P<0.01	supported

Conclusion

The research results reveal that a high-tech organization applying multimedia to innovation education would spend a lot of organizational resources, where managers, employees, systems, and workplaces are a part of organization innovation. A high-tech organization with innovation education would be willing to break through the past thoughts of internal communication, coordination, system, professional technology, and workplace. A high-tech organization with internal consensus to precede technology innovation could enhance the product innovation and process innovation. The application of multimedia to innovation education in a high-tech organization could positively affect technology innovation and entrepreneurial competitiveness. An organization applying multimedia to innovation education allows the personnel recruitment selecting innovation talents; and, the innovation planned by the system and the right distribution in workplaces allow the employees present certain rights. The entire organization would enhance the assumption of risk and bravely accept new opinions to show higher intention in the promotion of technology innovation to face the risk in the innovation and further promote the entrepreneurial competitiveness.

Suggestions

From the research results and findings, the following practical suggestions are proposed in this study.

1. Managers of high-tech organizations, from the leadership and participation, should stress on innovation education, keep open mind in management practice, workplaces, systems, and employee ability improvement to listen to more suggestions, broadly absorb new knowledge, precede benchmark learning, and learn the best practice in order to keep the leading management innovation, drive technology innovation, and acquire market entrepreneurial competitiveness.
2. A high-tech organization should judge the trend, grasp proper opportunities to seek for customers, suppliers, and academic research institutions, and apply multimedia to precede cross-organization innovation education cooperation and information exchange with the competitors so as to grasp the market news and entrepreneurial competitiveness.
3. A high-tech organization should promote individual entrepreneurial competitiveness in technology innovation as well as reinforce the cooperation in the industry, as the business model of competition and cooperation could promote the overall competitiveness of the industry and further enhance the entrepreneurial competitiveness of individual enterprise to form the benign cycle and cope with the harsher competitive market with the power of the entire industry.

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