# CONTENT VALIDITY FOR INNOVATION LEVEL OF UTM UNDERGARDUATE STUDENTS: A QUANTITATIVE APPROACH

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## Abstract

Innovation has become one of the vital aspects of a nation's human capital development. Most countries including Malaysia are now putting their best effort to increase their innovation capability in order to be more competitive in various aspects, especially in economy and technology. As one of Malaysian leading universities in engineering and technology, Universiti Teknologi Malaysia (UTM) emphasizes on innovation to all its students by establishing the Centre for Student Innovation (CSI). Its' objectives are to foster and enhance the innovation ability amongst UTM undergraduates. A question rising from this is, 'to what extent this objective has been achieved?' Therefore, it is very important for the UTM-CSI to ensure the effectiveness of their innovative programs that involved undergraduate students. Hence, the aims of this study are to develop and propose an instrument to facilitate UTM-CSI in assessing the level of innovation among UTM undergraduate students. A quantitative approach has been undertaken which includes document analysis from literature review, integration models and theories related to innovation and proposed human capital, and culture and leadership as constructs to develop the instrument in measuring the level of students' innovation. This article will report on the analysis of content validity and reliability using the Fleiss' Kappa Index where the inter-rater agreement on constructs studied is analyzed. The finding shows that the constructs and sub constructs indicated a high degree of agreement values that determine the validity and reliability of the development of instrument.

*Key words:* innovation, instrument, inter-rater agreement and content validity

## 1.0 INTRODUCTION

For the past 4 years, CSI-UTM has been facing a challenge in measuring the level of innovation among UTM students since it is very important for the UTM-CSI to know how the effectiveness of their innovative programs that involve students. Most of the existing instruments are focused on measuring the user's perceptions of IT innovation (Moore & Benbasat, 1991) and measuring the organization's innovativeness (Gamal et al., 2011). Thus, based on previous literature there is a lack of instrument to measure the innovation performance from the students' perspectives and it is essential (Adams et al., 2006) to put this forward as it should be developed further.

This study aims to develop an instrument for measuring the undergraduate students' innovation level that will provide useful data in facilitating UTM-CSI to assess the effectiveness of their prior and current innovation activities. Based on the issues highlighted, development of such instrument for measuring the level of students' innovation is crucial.

## 2.0 INNOVATION

Innovation can be defined as doing new things (Oxford University Press, 1998; Rosegger & Gerhard, 1986; West, 2002). Some authors' perceived that innovation is related to the establishment of new idea, experiment and process (Kanter, 1984; Urabe, 1988; West, 2002) which can be utilized in various aspects. Innovation leads to improvements and adaptations to the thought and ideas available to provide added value that can be applied, utilized and be used as a product or service that can be commercialized (Zaini, 2010). An innovative individual has the ability to reform or modify something to build better, exquisite and high quality, as a way of introducing new ideas to make something or create something new (Boon & Ragbir, 1998).

Many authors emphasized on the measurement of different dimensions of innovation. Founders with greater human capital are more likely to yield innovation outcomes (Kato et al., 2014). Thus, human capital can be seen as a catalyst in innovation (Leiponen, 2005) and to be an important driver of innovative performance, especially when the organizational support dimensions are limited. However, Subramaniam and Youndt (2005) found that human capital that interacts with social capital positively influence radical innovative capabilities whereas human capital by itself is not associated with radical innovative capability.

For example, Zhu (2015) considered seven factors of innovation which include organizational culture; goal orientation, participative decision making, innovation orientation, structured leadership, supportive leadership and shared vision. Hauser (1998) identified the

contents of organizational culture, which consists of (i.e. values, norms and knowledge), its strength, and structure (i.e. dealing with the culture-subculture problem).

A leader of an organization's characteristics in decision-making include introducing new ideas, setting specific goals and encouraging innovation initiative among subordinates, which is the most important leadership style and have also been stressed to influence the organization with innovation (Harborne & Johne, 2003; McDonough, 2000; Sethi, 2000).

Based on previous researches, three main constructs that determine the students' overall innovativeness were classified. They are Human Capital Innovativeness, Culture Innovativeness and Leadership Innovativeness. These dimensions are briefly summarized in Table 1. In line with these, students who tend to have the tendency to be innovative have the ability to foresight and have first class mentality in fostering a culture of innovation through a combination of innovation leadership styles.

**Table 1** Dimensions of students' innovativeness

| Author | Human Capital | Culture | Leadership |
|---|---|---|---|
| Lee et al. (2015) | X | X | |
| Schumpeter (2000) | X | | |
| George Couros, (2014) | | X | X |
| Chesbrough (2006) | X | X | X |
| Love et al. (2014) | X | | X |

## 2.1 Human Capital Innovativeness

Human capital consists of a set of knowledge, abilities and skills of individuals to boost the innovation process (Popescu & Diaconu, 2008), where the present set is highly required by young people equipped with the advancement of science and technology (Ramma et al., 2015). Santos-Rodrigues et al. (2010) focused on three dimensions of human capital; knowledge creation, innovative behavior and incentives for innovation. However, Human

Capital Innovativeness is most often referred to reduce the barriers of innovation represented by knowledge shortages and market uncertainties (D'Este et al., 2014) that comprised of three types of obstacles to innovation: cost, knowledge and market barriers.

Human capital innovativeness in this study refers to boosting the capacity of knowledge and innovation as well as nurturing first class mentality to stimulate the process of innovation. The desired human capital should be knowledgeable and skillful. Innovation knowledge has been recognized to play an important role (Rogers & Amidon, 1993) as an organizational attribute in fostering innovation (Dougherty, 1992). Innovation skills are practically the types of skills that allow individuals to become innovative in what they do (Certo et al., 2009). Among the skills referred to are cognitive skills, behavioral skills, functional skills and technical skills. To be an innovative student, problem-solving capabilities (Engestrom, 1999; Nickerson & Zenger, 2004; Von Hippel, 1994) must be brought together.

**2.2 Culture Innovativeness**

Culture innovativeness in this study refers to the characteristics, values, belief or willingness to change and trying something new that allows for innovation. Obviously, the key factor for success of an organization is a culture of innovation. Previously, the measurement of innovation culture in the context of company organization was endorsed by (Dobni, 2008) and the students' innovation product (Kamarudin et al., 2014). Research, program development and the involvement of members are very crucial in ensuring that the organization can persistently pursue innovation and compete in an ever-changing world. This form of cultural identity becomes the guidelines for workers in thinking, feeling and acting (Kalyani, 2011).

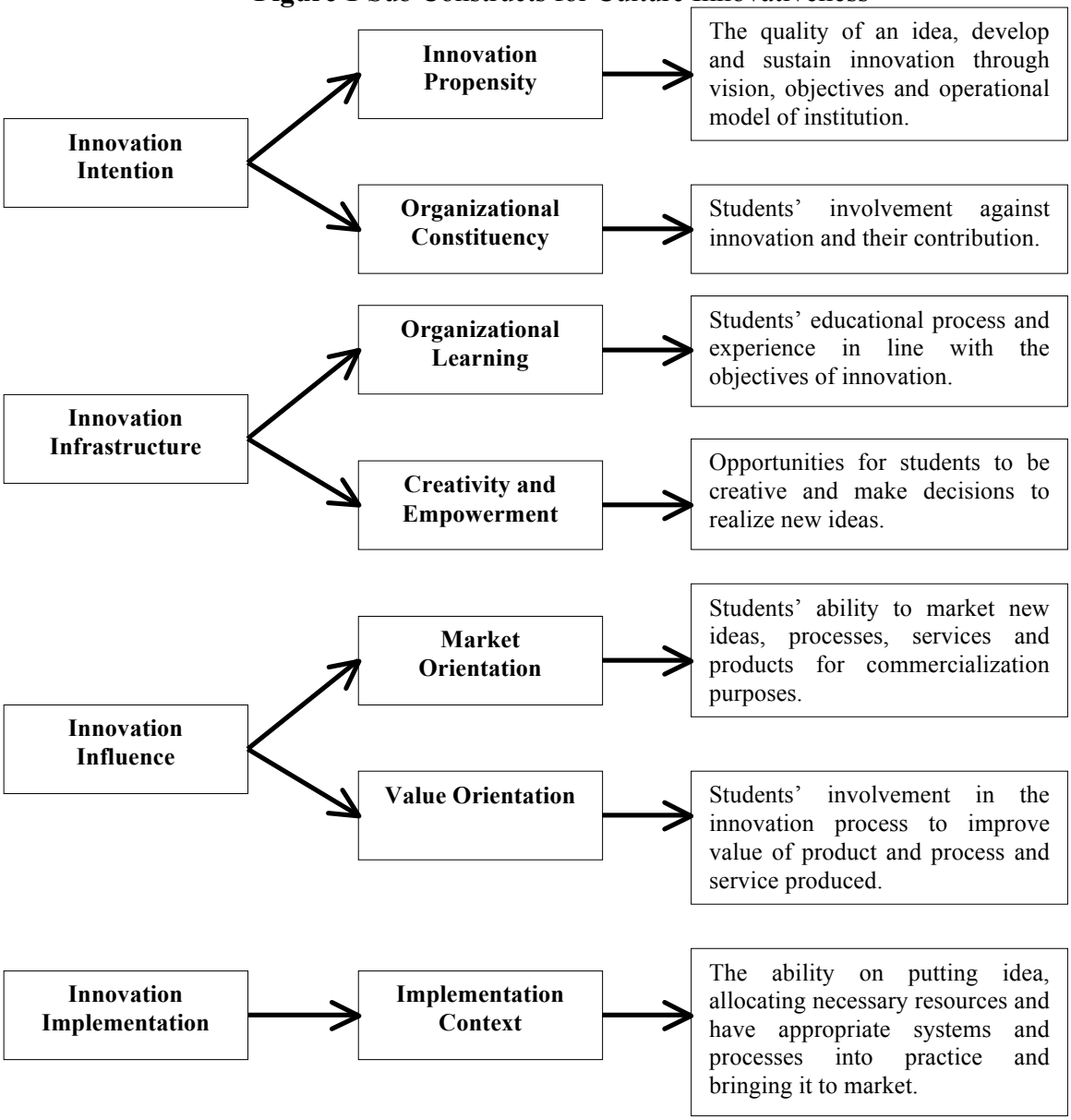
Empirical study on developing valid measures to assess innovation culture specifically, have been carried out by Dobni (2008) and he proposed an innovation model. In this study, the model was adopted as a measuring tool to assess the students' innovation culture. A few dimensions have been identified to measure the culture of organizations and they are emphasized in Table 2. It also becomes the basis to assess the students' innovation culture at UTM. Based on the dimensions, seven factors have been identified and they are used for sub constructs as shown in Figure 1.

**Table 2** Dimension of Innovation Culture

| **Dimension** | **Author** |
|---|---|
| Innovation intention | (Christensen et al., 2003; Dobni, 2006, 2008; Martins & Terblanche, 2003; Tesluk et al., 1997) |
| Innovation infrastructure | Dobni & Luffman, 2003; Hurley & Hult, 1998; Martins & Terblanche, 2003; Syrett & Lammiman, 1997; Tushman & O'Reilly, 1997; Wang & Ahmed, 2004 |
| Innovation influence | Aldas-Manzano et al., 2005; Day, 1990; Deng & Dart, 1994; Hult et al., 2004; Hurley & Hult, 1998; Kohli et al., 1993; Narver & Slater, 1990; O'Cass & Viet Ngo, 2007 |
| Innovation implementation | Bossidy & Charan, 2002; Day, 1990; Kohli & Jaworski, 1990; Marinova, 2004; Wang & Ahmed, 2004 |

Source: (Dobni, 2008)

**Figure 1** Sub Constructs for Culture Innovativeness




## 2.3 Leadership Innovativeness

Processes of influence or examples by leader to followers in order to achieve organizational goals are known as leadership. Besides that, it is the ability to guide others without any force into a direction or decision that leaves them feeling empowered and accomplished. Based on De Jong and Den Hartog (2007) findings, leadership refers to a process of influencing others towards achieving some kind of desired outcome, and leadership behaviors stimulate the employees' idea generation and application behavior. Most definitions

of leadership reflect some basic elements, including a "group", "influence" and "goals" (Bryman, 1992).

In the context of this research, leadership in innovation is the result of a combination of styles of leadership in the organization that aims to influence students to generate creative ideas, products, services and solution. Therefore, the researcher has to use the Big Five model of innovation to develop the measuring item. A sub construct identified through this model that is abbreviated to OCEAN consists of five elements. The sub constructs are based on the five-factor model. The big five factors which are openness, conscientiousness, extraversion, agreeableness and neuroticism are respectively defined in Table 3.

**Table 3** Factors of Leadership Innovativeness

| Leadership Innovativeness | Definition | Author |
|---|---|---|
| Openness | Innovative students are curious, original, creative and open to new ideas. | (Feist, 1999; King et al., 1996; Love et al., 2014; Martindale & Dailey, 1996; McCrae, 1987; Yi-Ching et al., 2013) |
| Conscientiousness | Innovative students lack in conscientiousness. They are not punctual, disorganized, independent and doubtful. | (Barron & Harrington, 1981; Feist, 1999; King et al., 1996; Patterson et al., 2000; Patterson et al., 2009; Walker et al., 1995) |
| Extraversion | Students that are extraverts are generally outgoing, sociable, assertive, talkative, energetic and optimistic. | (Aguilar-Alonso, 1996; Anderson et al., 2004; Graen & Scandura, 1987; King et al., 1996; Martindale & Dailey, 1996; Shin & Zhou, 2003) |
| Agreeableness | Innovative individuals are frequently described as hostile, challenging, rebellious, non-conforming and argumentative. | (Cooper & Robertson, 1997; Costa & McCrae, 1992; Hsieh et al., 2011; King et al., 1996) |
| Neuroticism | Innovative student tend to have greater emotional stability with low in neuroticism. Moderate levels of anxiety may enhance the innovation level. | (Chell & Karataş-Özkan, 2014; McCrae, 1987; McShane & Von Glinow, 2015) |

## 3.0 METHODOLOGY

The Quantitative methods are used to estimate the qualitative data resulting from the analysis of documents, literature review and meta-data analysis to generate constructs and sub constructs in developing the instrument. Three expert panels in innovation were selected to assess the instrument that consists of three main constructs, 15 sub-constructs and 107 items on a three-point scale (0 = disagree, 1= agree with modification 2 = strongly agree). The

Fleiss Kappa Index is used to identify the coefficient kappa,$\kappa$ which represents the ratio of agreement for examining the inter-rater agreement among the experts. The Fleiss Kappa is a statistical measure of inter-rater reliability. It is also related to the Cohen's kappa statistics, but it works only for two raters whereas the Fleiss Kappa works for three raters and above to give agreement on the categorical ratings.

The table below denotes the number of constructs and sub-constructs that represents the maximum number of each agreement achieved. This means that the value representing the sub constructs and item for each constructs multiplied by 2 is the maximum value on the three-point scale that indicates strongly agree.

**Table 4** Actual Agreement Value

| CONSTRUCTS | ACTUAL AGREEMENT VALUE | SUB-CONSTRUCTS | ACTUAL AGREEMENT VALUE |
|---|---|---|---|
| **Human Capital Innovativeness** | 3 sub-constructs = 6 | Knowledge | 7 items = 14 |
| | | Skills | 18 items = 36 |
| | | Towering Personality | 6 items = 12 |
| **Culture Innovativeness** | 7 sub-constructs = 14 | Innovation Propensity | 6 items =12 |
| | | Organizational Constituency | 6 items = 12 |
| | | Organizational Learning | 5 items = 10 |
| | | Creativity and Empowerment | 8 items = 16 |
| | | Market Orientation | 4 items = 8 |
| | | Value Orientation | 5 items = 10 |
| | | Implementation Context | 8 items = 16 |
| **Leadership Innovativeness** | 5 sub-constructs = 10 | Openness | 6 items = 12 |
| | | Conscientiousness | 7 items = 14 |
| | | Extraversion | 11 items = 22 |
| | | Agreeableness | 5 items = 10 |
| | | Neuroticism | 5 items = 10 |

Theoretically, in the Fleiss Kappa statistics, agreement can be considered as follows; if a fixed number of people assign numerical ratings to a number of items, then the kappa will give a measurement of how consistent the ratings are. The kappa, κ, can be defined as:

$$\kappa = \frac{\overline{P} - \overline{P}_e}{1 - \overline{P}_e}$$

Thus, from the above equation we can conclude that the kappa coefficient is equal to the degree of agreement that is attainable above chance by the raters over the degree of agreement actually achieved. The range value of $\kappa$ is between $0 \leq \kappa \leq 1$. To demonstrate the consistency among observational ratings, the researcher computed the Fleiss Kappa for Human Capital Innovativeness construct as below:

**Table 5** Fleiss Kappa Calculations

| Expert 1 | Expert 2 | Expert 3 | Kappa Value ($\kappa$) |
|---|---|---|---|
| 4/6 = 0.66 | 5/6 = 0.83 | 6/6 =0.83 | $\frac{0.66+0.83+0.83}{3}$ <br> $\kappa$=0.77 |

## 4.0 FINDINGS

The reliability index for all constructs in measuring the students' level of innovation is rated to obtain the Kappa statistics value as presented in Table 6.

**Table 6** Reliability Index for Each Construct of Students' Innovation.

| No | Innovation Constructs | ID Item | Total of Items | Kappa Statistics |
|---|---|---|---|---|
| 1 | Human Capital Innovativeness | HC01-HC31 | 31 | 0.77 |
| 2 | Culture Innovativeness | CL32-CL73 | 42 | 0.69 |
| 3 | Leadership Innovativeness | LD74-LD107 | 34 | 0.78 |
| **Total** | | | 107 | 0.74 |

The overall value of kappa statistics indicates 0.74 and based on Table 6, it comprises of 107 items showing that it has between intermediate and good level of agreement. Human Capital Innovativeness and Leadership innovativeness showed high agreement respectively, with 0.77 and 0.78 Kappa Statistics values. They were very significantly associated with the Fleiss' Kappa Benchmark Scale (refer Table 7) as they indicate a high degree of agreement values, which are more than 0.75. Meanwhile, Culture Innovativeness indicated between intermediate and good level of agreement as it recorded a kappa value of 0.69.

**Table 7** Fleiss' Kappa Benchmark Scale

| Kappa Statistic | Strength of Agreement |
|---|---|
| < 0.40 | Poor |
| 0.40 to 0.75 | Intermediate to Good |
| More than 0.75 | Excellent |

Source: (Fleiss, 1981)

Based on Table 8, the researcher emphasizes on the reliability of each sub-construct. Thus, the knowledge was its highest agreement among other sub-constructs under the Human Capital Innovativeness. Respectively, knowledge, skills and towering personality recorded kappa values of 0.83, 074 and 0.72.

However, in Culture Innovativeness, Market Orientation achieved a kappa statistics value of 0.35 among 7 sub-constructs, indicating the lowest value compared to other sub-constructs. In contrast, Value Orientation indicated 0.90, Implementation Context and Organizational Learning 0.80, while Innovation Propensity showed 0.78, which is a very high value of inter-rater agreement. Meanwhile, Creativity and Empowerment, and Organizational Constituency respectively showed 0.67 and 0.50, which classified the sub-constructs between intermediate and good level of agreement among raters.

Significantly, the sub-construct Openness consisting of 6 items recorded the highest agreement where all raters agreed with the items proposed. Neuroticism and Extraversion also indicated excellent strength of agreement between raters where both sub-constructs recorded 0.93 and 0.91 values of the kappa statistics, whereas Agreeableness and Conscientiousness demonstrated between intermediate and good level of agreement that correspondingly showed 0.57 and 0.48.

**Table 8** Reliability Index for Each Sub-Constructs of Students' Innovation

| Constructs | Sub-constructs | ID item | Total of items | Kappa statistics |
|---|---|---|---|---|
| Human Capital Innovativeness | Knowledge | HC01-HC07 | 7 | 0.83 |
| | Skills | HC08-HC25 | 18 | 0.74 |
| | Towering Personality | HC26-HC31 | 6 | 0.72 |
| Culture Innovativeness | Innovation Propensity | CL32-CL37 | 6 | 0.78 |
| | Organizational Constituency | CL38-CL43 | 6 | 0.50 |
| | Organizational Learning | CL44-CL48 | 5 | 0.80 |
| | Creativity and Empowerment | CL49-CL56 | 8 | 0.67 |
| | Market Orientation | CL57-CL60 | 4 | 0.35 |
| | Value Orientation | CL61-CL65 | 5 | 0.90 |
| | Implementation Context | CL66-CL73 | 8 | 0.80 |
| Leadership Innovativeness | Openness | LD74-LD79 | 6 | 1.00 |
| | Conscientiousness | LD80-LD86 | 7 | 0.48 |
| | Extraversion | LD87-LD97 | 11 | 0.91 |
| | Agreeableness | LD98-LD102 | 5 | 0.57 |
| | Neuroticism | LD103-LD107 | 5 | 0.93 |

## 5.0 DISCUSSION & CONCLUSION

In summary, Human Capital, Culture and Leadership innovativeness are positively associated in measuring the innovation level among UTM undergraduate students. Besides that, the sub constructs that have kappa statistics values of above 0.75 are Knowledge, Innovation Propensity, Organizational Learning, Value Orientation, Implementation Context, Extraversion, and Neuroticism. Meanwhile, Towering Personality, Organizational Constituency, Creativity and Empowerment, Conscientiousness, and Agreeableness have moderate level of agreement among raters.

From the data obtained, the researcher needs to modify and reword the sentence structure for the sub-constructs that have kappa statistics values between 0.40 and 0.75. If the constructs, sub-constructs and items evaluated by the three experts need to be modified or do not meet the criteria as an instrument, the researcher needs to repair the item first, and if it still does not fulfill the requirement, it should be dropped entirely. Besides that, this study demonstrates that the raters disagreed with putting Market Orientation as a sub-construct in Culture Innovativeness. Previous studies identified that Market Orientation is considered to produce; innovative organizations (Narver & Slater, 1990), superior performance in terms of

innovative business (Drucker Peter, 1954) and service industries (Grönroos, 1990). The researcher listed the items dropped in Table 9. Thus, the reliability and validity of instrument can be improved.

Table 9 List of Items Dropped to Improve Reliability

| ID | ITEMS CONTENTS |
|---|---|
| CL57 | Observed demands of the market first before create any innovation product. |
| CL58 | Always see business opportunities everywhere. |
| CL59 | Able to see gap in the market for new product that others may not be able to do that. |
| CL60 | Always seeking for ideas which competitors will target which set of customers. |

The use of the Kappa Statistics indicates the strength of agreement among raters as well as guiding the researcher to develop high reliability and validity of instrument, and assisting the researcher to create measurement items to cover the construct being measured.

In conclusion, all of the constructs are maintained as they have a relatively high value of agreement among raters. However, one of the total 15 sub constructs, Market Orientation, has been dropped and therefore, only 14 sub constructs and 103 items are maintained. Then, the researcher prepares and rearranges the item content to be used as a complete questionnaire. The researcher will carry out the pilot study by involving 30 undergraduate students who are studying at UTM.

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