Perceptions of Students' Innovation in Malaysian Premier Polytechnics: A Preliminary Study

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Received: 23 May 2020
Received in revised form: 23 June 2020
Accepted: 28 June 2020
Published: 1 July 2020

ABSTRACT

This research has been carried out to investigate the nature of innovation in by Malaysian polytechnics. Serving as a core for human capital development, innovation development is inculcated through students' final year projects in all Malaysian polytechnics nationwide. Students and lecturers from premier polytechnics were interviewed in this preliminary study. From the results, respondents are aware of the importance of innovation. However, a common misconception of innovation exists among students and lecturers alike, misinterpreting innovation to the likes of invention projects. As a result, polytechnics often focus on product innovation only. In fact, many antecedents for students' innovation, such as knowledge and skills for creativity are often overlooked. This is due to the fact that students and lectures lack exposure and guideline on the nature of innovation. As a whole, this research serves as a basis to understand students' innovation especially from their point of view and better prepare them for Industrial Revolution 4.0 (IR 4.0).

Keywords
Innovation, Polytechnic, TVET, IR 4.0

Introduction

Industrial Revolution 4.0 represents a digital transformation that will change the current Technical Vocational Education and Training (TVET) and industries worldwide. For Malaysian polytechnics, the move to innovate and adapt to such technological advancements is almost inevitable. In reality, innovation is an inevitable process of transforming for Malaysian polytechnics (Mat Arif, 2012). In such period of disruptive digital transformations, Schröder (2019) suggested three areas for thorough researching which are the future conditions of the world of work; personnel in respective TVET institutions to act as agents of change; and the quality of education required to bring up future skills (Schröder, 2019). Concurrently, the fostering of new skills has also been emphasized by several researchers. Toner (2010) defended the significance of innovation in vocational education in terms of skills formation. Moreover, the worker that are higher educated and skilled are argued to have greater 'functional flexibility' due to greater stock of knowledge which increases the rate at which they learn and develop higher order problem solving skills (Toner, 2011). This is also supported by Kim (2002) stating that more highly educated individuals tend to adopt innovations earlier and implement and adapt them sooner than less-educated individuals"
Polytechnics play a vital role in feeding human capital demands in Malaysia as it is the largest TVET provider with 55% of the TVET graduates nationally (MoE, 2018). Hence, while emphasizing for technical skills mastery, creativity and innovation is also main element in teaching and learning. In fact, students equipped with essential technical skill are seen as human resources with huge potential to exhibit creative and innovative works (Musta'amal, Mohtaram, Rosmin, & Fakhruddin, 2017). Consequently, a lot of platform is required for students to showcase their creative and innovative talents. For instance, Malaysian polytechnics have continuously organized final year projects' exhibitions and innovation products' competitions to encourage students' creativity and innovation.

However, such phenomena also generate a form of misconception among lecturers and students. Innovation does not depend on invention processes, and such processes tend to be undertaken as problem-solving within an ongoing innovation process rather than an initiating factor (Smith, 2005). According to Smith (2005), the fact that innovation is simply defined as novelty means that it is always synonym to the creation of something qualitatively new via processes of learning and knowledge building. In addition, it involves changing competences and capabilities and

producing qualitatively new performance outcomes. This may lead to new product characteristics that are intrinsically measurable in some way. In short, measurement of innovation should apply on the learner instead of the project outcome. In fact, technical measurement comparisons are only rarely meaningful across products as innovation involves multidimensional novelty in aspects of learning or knowledge organization that are difficult to measure or intrinsically non-measurable (Smith, 2005).

Innovation is a learning process which involves multiple inputs (Smith, 2005), instead of technical. This is also supported by the works of Kline and Rosenberg (1986) which highlighted the importance of non-R&D inputs to innovation-design activities, engineering developments and experimentation, training, exploration of markets for new products. This is especially true for polytechnic students as they can explore or exploit their ideas through implementation of the final year projects. Moreover, individual knowledge and skills which have been accumulated throughout their learning period are actualized into in forms of products. On the other hand, they can recruit help from their project supervisors, other lecturers, polytechnic staffs, and even older peers to seek advice in completing their projects. Very often, students are required to participate actively and make use of their creativity while working as a team to ensure the introduction of their innovation is a success. Therefore, although innovation is immeasurable, innovation can be traced by measuring students' creativity via the multiple inputs available in polytechnics.
In conclusion, innovation development among polytechnic students require strategic planning in executing the educational models within each learning institutes, polytechnics alike (KPM, 2015). Therefore, the careful analysis of the applications is vital to ensure educational success.

Research Objectives

By achieving the objectives below, the contribution of this study is twofold.
1. To explore perceptions and identify factors of innovation among polytechnic lecturers and polytechnic students.
2. To identify issues and challenges for students' innovation in polytechnics.

Methods

This research employed a semi-structured interviewing technique preceded by a systematic methodology, as described by Kallio *et al.* (2016). The semi-structured interview was conducted due to lack of literature evidence on polytechnic students' perceptions of innovation. Although student's innovation also involves creative thinking and conceptualization of problems, the implementation of such teaching is rarely reported in polytechnics. Instead, reports of student's innovative products were widely recorded as they win prises and awards. As there is a lack of studies regarding this issue, we decided to approach lecturers and students in polytechnics to address the empirical state of the teaching of innovation. To achieve this, the results of semi-structured interviews were analyzed qualitatively. In fact, the interview format incorporates both open ended questions, and other emerging questions from the exchanging dialogues between researcher and respondents, to gain deeper understanding of the research topic.

The data for this study was collected by interviewing three polytechnic students and three lecturers from two selected polytechnic in Malaysia. The lecturers were selected via three criteria: (i) Have more than 3 years teaching experience from any engineering department, (ii) Have experience guiding students' final year projects and (iii) Have at least one experience of guiding students entering a state or national level innovation competitions. Meanwhile, students were also selected via three criteria: (i) Have completed their final year project, (ii) Have at least one experience of entering state or national level innovation competitions, and (iii) Have been graded "excellent" for their project.
The design and development of interview protocol were constructed in line with the guidelines that were commonly mentioned in prior research (Abu Hassan et al., 2013). Based on a comprehensive review of the relevant literature, the instrument was prepared to investigate the following three issues of students' innovation: perception of innovation, and implementation of innovation and the barriers to innovation. The qualitative responses were categorized using thematic analysis (Boyatzis, 1998) to understand influences on the four issues on students' innovation.

Lastly, to ensure anonymity of respondents, the names of academicians were substituted with "A, B and C" in the report below.

Table 1. Interview protocol used in the preliminary interviews

Main Issue	Questions
Perception of Innovation	Q1: What is innovation?
Implementation of Innovation	Q2: How is innovation taught among students?
Barriers to Creativity and Innovation	Q3: What are the perceived problems to the implementation of creativity and innovation in polytechnics?

Data Analysis

A thematic analysis was employed to analyse the interview transcripts. The analysis resulted in three basic themes which were innovation perceptions, reality in innovation of polytechnics and challenges in implementation
The transcribed interviews were analysed by using a grounded theory-led thematic analysis approach (Braun and Clarke, 2006). The analysis took place in three stages. First, all the textual units on gender were coded. Second, the codes were reviewed, and thematic categories were formed. Finally, the thematic categories were grouped into broader themes and sub-themes. Research participants were offered full anonymity in the study, therefore in the paper pseudonyms have been used instead of real names.

Results and Discussion

As the interviews were conducted, various views on innovations were declared and clarified. Most of them are not aware that the process of learning is related to innovation, although nearly all have high awareness on the importance of innovation. It can be concluded that many respondents appeared to give opinions, describing innovation during the interview.

The Perceptions of Innovative Projects: Implications on Creative Skills

Innovation and creativity are related to each other. However, most people do not realise the differences and often mistook one for the other. In fact, respondents tend to define innovation similar to invention. Lecturers' perceptions were investigated to open path for the researcher to understanding the implementation of innovation projects amongst polytechnic students.

> *Mr. A, Lecturer (PUO): From the product then innovation exists… At the beginning stage of proposal development (of the innovation project), students are divided into groups and assigned a task which is to brainstorm an appropriate idea by their supervisors. Mostly, students come out with different ideas of innovation according to their field of study.*
>
> *Madam B, Lecturer (PIS): …the way the product is created and the initiatives for improving its features. That is called innovation.*
>
> *Miss C, Lecturer (PUO): …the final year innovation project for students are (their) platform for creativity. In groups, they practice their hands-on skills by either inventing or improvising a product according to their creativity.*

Excerpts from different interviews reflected that most lecturers share a common view. Lecturers often relate innovation to invention where a desired product is developed over time. Although no formal teaching and learning were done specifically for creativity, respondents were able to draw similarities between project-based learning and creativity.
As for students, a brief definition of innovation was given below:

> *Ammar, Student: Innovation is simple, things that exist, we improvise.*

On the other hand, implementation of innovations for polytechnic students are seen as applying technical skills which improves an existing product.

Mr. A, Lecturer (PUO): Normally, what we do in the project is developing products. So, products (available) in (current) market, we improvise it…. …it requires hands-on skills. That is, the skills that they (students) have acquired from the "bengkel" (workshops).

Madam B, Lecturer (PIS): It is nearly impossible to complete the innovation project without required technical skills. That is most important. And we make sure they (the students) are competent.

Miss C, Lecturer (PUO): They (The students) were taught engineering skills... ...these are important for their future career and, of course, applied in their final year projects.

Miss C, Lecturer (PUO): Students need to be technically skilful only then they can know what to do.

In fact, lecturers see a minimum level of expertise is required for students to implement an innovation. This is also similar to the componential theory of creativity which advocates the influence domain related knowledge on students' creativity (Kozbelt, Begheuo, & Runco, 2011; Runco & Chand, 1995). This is also similar to a model presented by Michael Dahlen in *Creativity Unlimited* explaining the creative process as three parts: knowledge, motivation, and situation (Dahlen, 2015). However, over-emphasis of technical skills (knowledge expertise) would also kill creativity. According to Burkus (2013), research into the lives and careers of creative people shows that, at a certain level, expertise can actually hinder the creative ability of individuals and decrease their creative output. "*expertise can actually hinder [the] creative ability of individuals. ... As expertise grows, creativity sometimes diminishes. Sometimes the best insights come from those outside a particular field,...*" (Burkus, 2013).
Similarly, the excerpts from polytechnic students also supported that the final year project prompted them to apply various skills during product development

Ammar, Student: From it (final year project), I am more confident with my hands-on skills. And I observed that my group members and I are able to engage with engineering skills competently. Also, (we applied) communicating skills, problem solving skills, project management skills and more.

Adib, Student: We learn better from (engaging with) the project. We do everything, hands-on, ourselves. When we are unable to do it (hands-on activities), we will ask lecturers to demonstrate it for us.

Akmal, Student: I was able to apply the skills that I learned previously. Even skills from other departments… …in my case, skills from the electrical engineering department, such as electrical circuit design.

As a conclusion, the implementation of the final year project has a positive effect on students' perceptions of technical skills.

Innovation in Polytechnics: Awareness and Practical Reality During Teaching and Learning

Although respondents were asked to describe the "innovation" of their projects in a broadly manner, the first impression of their experience is always positive. Many students and lecturers indicated that the project-based learning is able to promote students' creativity, encourage application of technical skills and soft skills through real life interactions with people and team members. Unfortunately, there are no valid guidelines or models available for lecturers in propagating creativity and innovation. This is also in line with research by Hashim *et al.* (2019) that perceived a lack of guideline to produce an innovative output. As a result, lecturers was doubtful in producing innovative ideas for teaching (Hashim, Saharani, Zulkifli, Mokhtar, & Yunus, 2019).

Madam B, Lecturer (PIS): So far, we only teach students (to) do proposal and guide them in their final year project. There is no guideline to teach them creativity or innovation.

When innovation and creativity were mentioned, respondents frequently related to their experience with their final year projects. This further supports various researchers on the role of hands-on teaching and learning upon students' creativity.

Madam B, Lecturer (PIS): The hands-on project they do is able to make them creative.

Meanwhile, it is also worth mention that respondents also believed that project-based learning is able to compensate for the absence of a formal creative teaching and learning.

Miss C, Lecturer (PUO): We don't have teaching materials to teach innovation, but we teach them informally through their final year projects.

It is very widely known that project-based learning has a very special role in stimulating students' creativity. But it is also argued that students should be taught relevant knowledge regarding creative skills which can assist their creative thinking. Unfortunately, the body of knowledge specifically for students' creative skills is absent from the current curriculum, parallel to the statement below:

Akmal, Student: I think... We all don't really know the process of creativity. We sit together, discuss, and think things through.

Adib, Student: No, there is no class to teach creativity. But I think we learn these (creative skills) indirectly through class assignments and the final year innovation projects.

Akmal, Student: I think we are creative, but we did not undergo any written tests about creativity. We only develop a product that can help us show that we are creative.

Ammar, Student: … if there is a chance, I would definitely try it (innovation project) again… it helps me think in an innovative and creative way.

From the statements above, it can be portrayed that respondents reported positive perceptions on their creativities; however, accurate accounts of improved creativity amongst students are unavailable. In fact, both students and lecturers showed positive perception on creativity development without clear indications of following the creative thinking process. Below, the explanation shows lack of ideation (an example of creative skill) by students:

Ammar, Student: At first, we wanted to do material innovation. But our supervisor said: "Why don't you look around this office and innovate this one product instead"

Madam B, Lecturer (PIS): If possible, we would advise students to engage with a project which does not consume too much time. Because we have catch up with the syllabus (content). For certain projects (that are not feasible), (because) we do not have enough resources and technology. So, we need to consider that as well.

These articulations indicated that lecturers tend to avoid creative thinking process in classes, by labelling it as wasting resources and having limited time for content deliveries. This is also evident from previous researches (Bailey & Colley, 2015). Meanwhile, few ignored the application of creative thinking process for project development as students are required to follow a tight schedule; hence, reducing time for students' "idea incubation" phases.

The Complications of the Implementation of Final Year Projects and Their Effects Upon Students' Creativity

The process of innovation often meets obstacles that hinders progress. For final year projects in polytechnics in Malaysia, there are reports of lack of time and resources that exists as constraints for teaching and learning creatively.

Mr. A, Lecturer (PUO): It isn't to invent something that never exists. That isn't possible in a year's time.

Mr. A, Lecturer (PUO): And maybe radical innovation does not exist as much as incremental innovation due to lack of budget and time constraints.

Madam B, Lecturer (PIS): Due to time constraints, we need to teach polytechnic students to be technically competent as such skills require more time to be sharpened.

From the excerpts of interview above, it can be concluded that academicians are concerned with the time constraints as they need to follow the teaching content and milestones. Therefore, limiting the time and spaces for teaching creative skills. This is parallel to most studies which viewed time and other resources are important for students' creative learning (Cheng, 2010; Lassig, 2012, Davies *et al*., 2014). Lassig (2012) listed down the main inhibitors of student creativity which includes lack of time for creativity. These include various tasks and the time needed for creative process (ideation, incubation, and production). Likewise, lack of resources, such as environment, social support, and stimuli, were also the barriers to creative teaching and learning (Lassig, 2012). In a detailed explanation

by Cheng (2010), Chinese lecturers lamented on the lack of time for students' participation in creative activities (think, discuss, practice, report, share and work). Meanwhile, they were also allocated little time for class instructions and explanations. As a result, this led to students having difficulties in learning and poor performance, experienced stress, and shunned creative learning (Cheng, 2010). Thus, it is important for polytechnic lecturers to perceive that their institution is willing to invest the time and money necessary to support innovation and implementation (Hashim *et al.*, 2019).

Finally, there is a need to consider the scale of students' final year projects. This is to ensure project feasibility and balance appropriate resources and time without sacrificing student's motivation and knowledge for creativity. Therefore, the development of a structural model is suggested by Hair *et al.* (2010) as it is able to address the various variables that were stated above. It is hoped that the model serves as a guideline for academicians as well as lecturer to provide creative and innovative teaching and learning effectively.

Conclusion

In a nutshell, this research unveils the current status of creative and innovation for polytechnic students. It is undeniable that polytechnic students are expected to be well prepared to face the industry and the neglect of students' innovation will be disastrous. In the real world, less creative and innovative students will face difficulty to perform (Wilbur, 2013). As a matter of fact, NIPO Research Institute (2002) reported that 20% of Dutch employers suffer structural losses due to a lack of innovation capability (Assink, 2006). Worse still, it was predicted that many technical skills will soon be substituted with robots and sophisticated technologies which can perform better with less error (Dede, 2009) parallel to the Industrial Revolution 4.0. Therefore, the focus of polytechnics should also include innovative human capital too (Normah, 2015). Apart from this, different types of creative processes require different types of skills. For instance, the componential theories advocates problem finding skills, ideation skills and idea evaluation skills which are compulsory for students' creativity. For future research purposes, this paper sets as a foundation for a model development for students' creativity for product development in their respective final year projects.

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