Exploring Trends of Innovation Types in Final Year Projects of Undergraduate Students

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Abstract
For higher education to sustain in the future and fulfil the future employment, innovation is the key where it is essential for higher education preparing students to be innovative. This research examines final year projects completed by undergraduate students in order to identify the forms of innovation based on the Doblin Ten Types of Innovation Model. A systematic sampling method was deployed to gather data from students from seven programs in one of higher institutions in Malaysia. In the survey, 164 samples were selected out of 285 students, and excel functions were used for descriptive data analysis. The top three ranking of innovation are: Service, Product System and Process respectively. The last ranking is Structure. Essentially, the outcome of the paper is relevant to assist the effort of innovations in Malaysia higher education and enhancing the employability skills of the students via industry-university collaboration.
Keywords: Technological Innovation, Doblin 10 Types of Innovation, Employability Skills, Student Innovation Capacity.

Introduction
Enrolment of students in Higher Education (HE) is decreasing. A report by China Press indicated that 390,000 Sijil Pelajaran Malaysia (SPM) graduates (72.1%) have no plans or interested in pursuing further education. In addition, The Department of Statistics Malaysia (DOSM) found that the greatest percentage of graduates who were unemployed was 4.4% (202,400 graduates), compared to 2019, when the unemployment rate was 3.9% (165,200 graduates). As a result, youth believe there is little point in continuing their education if they are unable to find work in the future. This would hinder a strong economy and bright future of the nation. Thus, HE plays an active role and innovate to stay relevant in the future.
Innovation is a new or improved ways of doing things, whether in the process, method or products or services. The ability to innovate has been found to be strongly connected and has positive impact with business performance (Expósito & Sanchis-Llopis, 2019; Singh & Hanafi, 2020; Somohano-Rodríguez et al., 2022). Not only innovations have a positive impact on the business, it positively impact healthcare Moreira et al (2017), agriculture Ho et al (2018);

Senyolo et al (2018), tourism Romão & Nijkamp (2019) but also higher education (Jackson, 2019). According to a recent meta-study by Sarooghi et al (2015) innovation and creativity have a strong relationship, especially at the individual level. Hence, educational institutions need to prepare students to be innovative and creative (Brøndum et al., 2019). As technology continue to grow in Malaysia, HE must provide program that cater the growth in information-and-technology-related. Substantially, institutions of higher education have not adapted continuously to external stakeholder demands (Pucciarelli & Kaplan, 2016). Hence, this research, able to prove that claim to some extent. From the curricular learned in the university, students acquire critical thinking, confidence, and essential skills for the future.

Creativity, Student innovation Capability and Employability Skill
Creativity is identified to be one of the personal attributes other than these highest important skills: communication problem solving decision making and teamwork. A recent meta-study by Sarooghi et al (2015) presented that there is a strong positive relationship between creativity and innovation, especially at the individual level. In the 21st century, occupation specific skills are not only sufficient but additional set of skills attributes known as employability skills are also needed.

In this study, student innovation capability is defined as the ability to constantly transform knowledge, skills and creativity into innovative products or services. The student innovation capability is displayed as an individual project proven by a study (Iddris et al., 2023). Meanwhile, a study by Pilav-Velic et al (2020) showed that the students displayed personal innovativeness deemed to be more employable. In the domain of employability, Ferns et al (2019) highlighted apart from skills, creativity is important for future workforce demands as well as Work-Integrated Learning (WIL) adopted through university-industry collaboration influenced skill development, and therefore have a positive impact on self-confidence and the ability to tackle unfamiliar learning experiences.

Final Year Projects
In Universiti Teknologi MARA (UiTM), Final Year Project (FYP) is a compulsory requirement of graduation in bachelor programmes in the College of Computing, Informatics and Media, Malaysia. Every third-year student must complete their computing projects. The students experience hands on planning, analysis, design, and development phases in handling as well as solving information technology and computing sciences project which later demonstrated the outcome as knowledge sharing. This is to build the confidence, inculcate critical thinking, independence, creative and innovative.

This study explores the student's innovation capability with potential areas for innovation through final project developed by the students were mapped and categorized under Doblins 10 Types of Innovation. This study applied Doblin's Ten Types of Innovation model because it is the industry standard, widely applied, and highly practical as a diagnostic tool and competitive analysis tool for most consumer product/service organisations (Abdallah & Foulds, 2019). The table below shows the details for each innovation theme, type, and description of the Dublin 10 Types of Innovation.

Table 1
Ten Types of Innovation (source: Keeley et al., 2013).

Innovation Theme	Innovation type	Description
Configuration	Profit Model	How businesses generate revenue
	Network	Relationships with others that add value
	Structure	Organisation of the business's resources and talent
	Process	Excellent work-process characteristics
Offering	Product Performance	Unique characteristics and personality
	Product System	Supplementary products and services
Experience	Service	Service support and enhancements related to product offering
	Channel	How products and services are distributed to customers and end users
	Brand	Representation of the company's products and operations
	Customer Engagement	Distinctive interactions companies Foster

Methodology
This study focused on the FYP students in College of Computing, Informatics and Media, at one of higher institution in Malaysia, which included 7 course programs. 164 samples were selected out of 285 students. The determination of sample size was obtained by referring to the (Krejcie and Morgan, 1970). Then, the systematic sampling applied to choose the selected samples. A set of questionnaires was prepared to achieve the objective of this study, whereby there are 6 questions. The method of data collection used was a direct questionnaire that was distributed during FYP presentation day.

Data that has been collected was analysed using Microsoft Excel to represent the descriptive analysis. Charts, frequency tables and cross-tabulation tables were used to represent the findings.

Findings and Discussions
This study involved male 89 (54.3%) and female 75 (45.7%) students. According to the survey, there are 164 respondents involved. There were 38 (23.2%) from CS266 (Information Systems Engineering programme), 30 (18.32%) from CS230 (Computer Science programme), 26 (15.9%) from CS253 (Multimedia Computing programme), 25 (15.2%) from CS251(Netcentric Computing programme), 20 (12.2%) from CS246 (Information Systems Engineering programme) and 2 (1.2%) from CS245 (Data Communication and Networking programme).
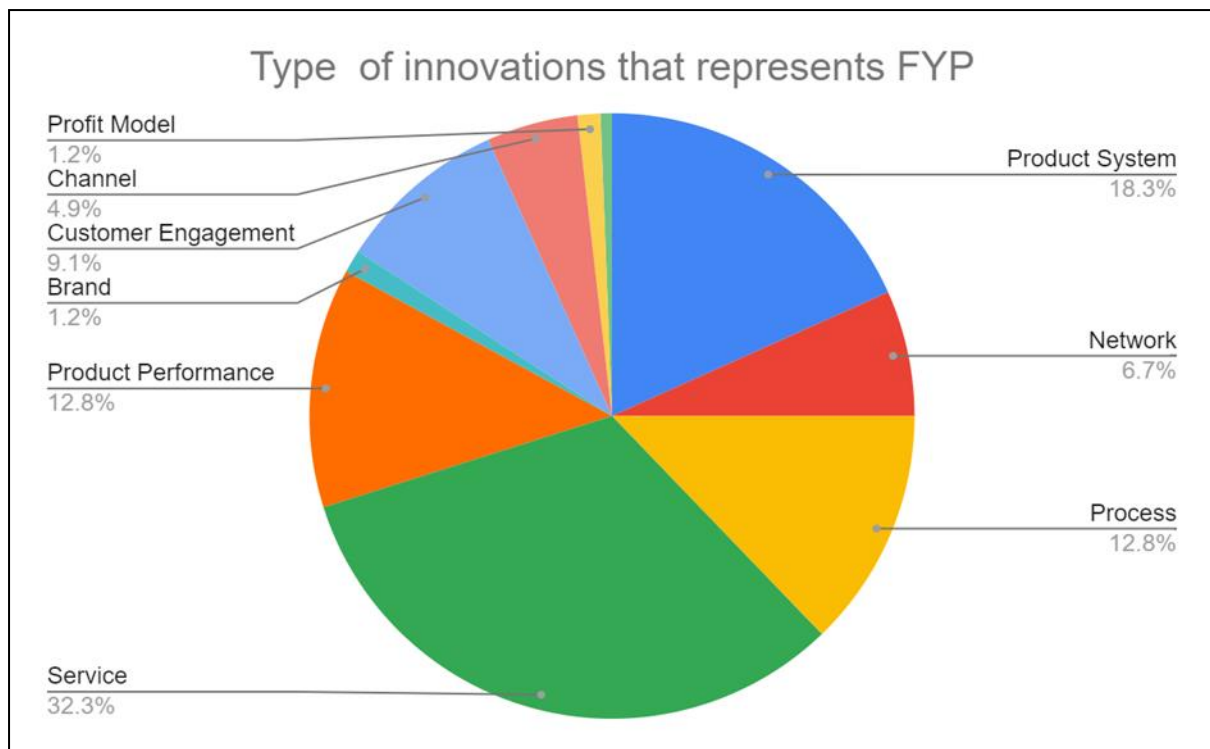
Figure 1: Type of innovations that represents FYP

Figure 1 depicts the type of innovations that represent FYP. Based on the pie chart, it was revealed that 'service' has the highest FYP trend of innovation types among the 10 Doblin's listed with 32.3%. The second highest trend is 'product system' followed by 'process' with 18.3% and 12.8%, respectively. Next trends of innovations that respondents performed in FYP are 'product performance', 'customer engagement', 'network', 'channel', 'brand', 'profit model' and finally 'structure'. 'Structure' had the least amount of frequency at 1 which is 0.6% of respondents. Detailed descriptive analysis for the data in the pie chart is also represented in the frequency table in Table 2.

Table 2
Frequency table of type of innovations that represents FYP

Type of innovations that represents FYP	Number of Students	Percentage
Service	53	32.31707317
Product System	30	18.29268293
Process	21	12.80487805
Product Performance	21	12.80487805
Customer Engagement	15	9.146341463
Network	11	6.707317073
Channel	8	4.87804878
Brand	2	1.219512195
Profit Model	2	1.219512195
Structure	1	0.609756098

Table 3 depicts the cross-tabulation table of types of innovations that represent FYP based on course program. From Table 3, it shows that CS230 and CS251 programs had the highest trend

of innovation types 'service' with 12 and 17 projects, respectively. The 'project system' was the highest innovation type among students from CS266 and CS255 interested to do so for their FYP. Meanwhile CS253 had the highest trend on 'customer engagement' and 'channel'. CS246 and CS had the highest trend on 'service' and 'process'.

Table 3
Cross-tabulation table of type of innovations that represents FYP and courses.

Type of innovations that represents FYP	COURSE PROGRAM							TOTAL
	CS230	CS245	CS246	CS251	CS253	CS255	CS266	
Service	12	1	6	17	4	4	9	53
Product System	2	0	3	3	3	6	13	30
Process	3	0	6	3	1	0	8	21
Product Performance	8	0	4	1	4	3	1	21
Customer Engagement	4	0	1	0	7	1	2	15
Network	0	0	0	0	0	8	3	11
Channel	1	0	0	0	7	0	0	8
Brand	0	0	0	1	0	0	1	2
Profit Model	0	1	0	0	0	0	1	2
Structure	0	0	0	0	0	1	0	1
Total	30	2	20	25	26	23	38	164

Table 4 depicts the cross-tabulation table of types of innovations that represents FYP based on gender. According to Table 4, male students preferred 'service', 'product system', 'process' and 'customer engagement' more compared to the other innovation types. Meanwhile, female students preferred 'service', 'product system', 'product performance' and 'process' more compared to the other innovation types. Thus, it can be concluded that both male and female students most preferred 'service' and 'product system' to their FYP. On the other hand, the least preferred innovation type was 'brand' among genders.

Table 4
Cross-tabulation table of type of innovations that represents FYP and gender

Type of innovations that represents your FYP.	Gender		TOTAL
	Male	Female	
Service	27	26	53
Product System	17	13	30
Process	10	11	21
Product Performance	8	13	21
Customer Engagement	10	5	15
Network	9	2	11
Channel	4	4	8
Brand	1	1	2
Profit Model	2	0	2
Structure	1	0	1
Total	89	75	164

Conclusion and Recommendations

It is important for the university to prepare the students employee abilities skills other than work specific skills. Higher education must engage more fully in learning cycles that can absorb and adjust to external market demands and information.

Innovation produced in FYP were mapped to 10 Doblin types. From the results, the most preferred types of innovation in the FYP mapped to the 10 Doblin Type of Innovation is 'Service'. Many products produced an innovation to support serving customers such that to find, buy and consume in daily life. The idea of selecting service-based innovation comes from the experience. Structure is in the last ranking based the Doblin model as talent and assets were organized within the company. As FYP were completed on a limited time and restricted capacity of a student, innovation on structuring was unpopular.

The ranking of innovation are follows: first is Service, second is Product System, third is Process, fourth is Product Performance, fifth is Customer Engagement, sixth is Network, seventh is Channel, eight is Brand, the second last is Profit Model and the last ranking is Structure. Based on the findings it can be recommended the institution to support a variety of innovations and provide platforms that facilitate innovations on the lower rank.

This is study is preliminary to introduce the 10 Doblin types of innovation correspond to FYP. Identification of innovation type shall be made primarily during the project proposal. Data was collected among undergraduates for one semester only. It is recommended that a longitudinal study be implemented in which the pattern of the types of innovation by year or semester study over time. Comprehensive information and explanation about the 10 Doblin types in innovation should be addressed to correspondents prior to the survey.

Nevertheless, this study revealed that 'Experience' is the innovation theme that students most doing in FYP since Service was the highest count among the other innovation types.

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