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Graduate's Generic Attributes Through UTM Physics Education

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ABSTRACT: This study is to investigate the perception of physics undergraduates, physics lecturers and employers regarding the development of UTM graduate's generic attributes through physics studies. This study helps to understand the differential perceptions among the parties in order to minimize the gap between needs, taught and learned of the generic attributes. A total of 104 physics undergraduates and 27 physics lecturers had participated in the questionnaire section while 3 employers were participated in the interview section. Data collected from questionnaire were interpreted and evaluated using descriptive and inferential statistics. Mann-Whitney U test and Wilcoxon Signed Ranks test with significant level p=0.05 were used to evaluate the ordinal data collected from questionnaire. Interview data were recorded and summarized to identify key categories and features. As the result, participants from three categories had respective perception regarding the development of UTM graduate's generic attributes through physics studies. By understanding the employers' needs on the generic attributes possessed on graduates, lecturers can play an important role in embedding the desired attributes into curriculum. Hence, it helps undergraduates to improve their learning of generic attributes based on the employers' needs through physics studies.

***Keywords**: Generic, Physics & Education*

ABSTRAK : Penyelidikan ini bertujuan untuk mengetahui persepsi para mahasiswa fizik, pensyarah fizik dan pengusaha mengenai perkembangan kemahiran generik sarjana UTM melalui pembelajaran fizik. Penyelidikan ini membantu untuk memahami perbezaan persepsi di antara para respondan untuk mengurangkan jurang antara keperluan, pengajaran dan pembelajaran kemahiran generik. Sebanyak 104 mahasiswa fizik dan 27 pensyarah fizik telah menyertai dalam bahagian senarai soal jawab sedangkan 3 pengusaha menyertai dalam bahagian temuduga. Data yang dikumpul dari senarai soal jawab ditafsirkan dan dinilai dengan menggunakan statistik deskriptif dan inferensial. Mann-Whitney U test dan Wilcoxon Signed Ranks test dengan tahap signifikan p = 0.05 digunakan untuk menilai data ordinal yang dikumpulkan dari senarai soal jawab. Data temuduga dirakam dan dirangkum untuk mengenalpasti cirri-ciri penting yang berkaitan dengan kemahiran generik. Akibatnya, peserta dari tiga kategori mempunyai persepsi masing-masing mengenai perkembangan kemahiran generik sarjana UTM melalui pembelajaran fizik. Dengan memahami keperluan pengusaha terhadap kemahiran generik yang perlu dimiliki oleh para mahasiswa, pensyarah boleh memainkan peranan penting dalam menanamkan sifat-sifat yang diinginkan ke dalam kurikulum. Dengan itu, ini dapat membantu para mahasiswa untuk meningkatkan pembelajaran kemahiran generik berdasarkan keperluan pengusaha melalui pendidikan fizik.

***Kata Kunci** : Generik, Fizik & Pendidikan*

1.0 INTRODUCTION

Every year thousand of graduates are celebrating their completion of tertiary education and enter the world of career to contribute their knowledge and work force for the nation wealth growth. However, year after year, the tracer study conducted by the Ministry of Higher Education is still indicating a group of unemployment graduates. Surprisingly, the percentage of the unemployment graduates from science study was the highest among other field of study. The percentage was 39.8% in the year of 2006, 29.2% in the year of 2007 and 26.2% in the year of 2008 from the total number of graduates in all level, including diploma graduates, first degree graduates and post graduates (Abu Bakar et al, 2009). Although the percentage was reducing, it is a perennial problem where no permanent solution had been discovered yet.

Thus, it comes to the question that; - do our tertiary educational institutions need to be reinvented to produce more employable graduates? What do employers want the Malaysian education to equip the graduates so that they will be more creative, knowledgeable and value is added to their work place? Hence, universities had been urged to make more explicit efforts to develop the 'key', 'core', 'transferable', 'soft', 'employable' and/or 'generic skills' needed in many types of employment (Gurvinder and Sharan, 2008). Research also indicated the existence of a skill gap which is the difference between the skills needed on the job and those possessed by applicants in between the graduates and employers. Realising that the incorporation of employability skills into the syllabus is not oppositional to quality learning, the Ministry of Higher Education has identified seven soft skills that should be possessed by all graduates in the areas of: communication; critical thinking and problem-solving; teamwork; lifelong learning and information literacy; entrepreneurship; professional ethics and morality; and leadership. (Ching, 2009)

2.0 LITERATURE

AIP had suggested that physics education had prepared graduate a variety of soft skills such as problem solving skills, critical thinking skills and cognitive skills.However, students tend to value and develope problem solving skills and critical thinking skills most through physics program. (O'Byrne and Mendez, 2008; Roman, 2000; Sharma et al, 2008; Wiata, 2006; Zegwaard and Hodges, 2003;) It happen due to the nature of physics program in which problem solving and critical thinking seen as being integral to the nature of Physics curriculum and are taught explicitly where students are given many different opportunities to practice the various forms of problem solving models (Thomas and Jones, 2007).

On the other hand, research indicates undergraduates learn least on ethical and social issue through Physics program. This had supported by the research done by Leeuwen et al. (2007) on the ethical issues in science education with 13 academic staff from science education. The finding form the research indicates that academic staffs did not consider ethics as relevant to their courses. Although lecturers considered the importance of ethics, only issues regarding academic honesty was being discussed frequently with their students. Respondents commented about time constrain and subject context which focus on technical and mathematical content.

There is a common perception from employers' view, where most physics graduates possessed problem solving and critical thinking skills (Coll et al. 2002 and Sharma et al. 2008). These results are similar to the Report of Inquiry into Undergraduate Physics by Institute of Physics, United Kingdom (2001). From the report, employers valued physics graduates as they possessed the flexibility and versatility in tackle wide range of technical and non-technical subjects, and good analytical and problem solving skills. On the other hand, the

report from the Institute of Physics, (2001) also indicated that employers would wish that physics graduates can improve social, interpersonal and team working skills as well as to have a better communication skills. This result had been supported by the research done by Sharma et al (2008) and Martin et al. (2008) where employers viewed that communication and interpersonal skills as very important at workplace.

3.0 RESEARCH PURPOSE

The purpose of this study is to develop a framework (Figure 1) in order to investigate and understand the UTM graduate's generic attributes learned through Industrial Physics Program, (SSF). The study will be investigating the perception from three parties, which are Physics undergraduates, Physics lecturers and employers. By understanding the employers' needs on the generic attributes possessed on graduates, lecturers can play an important role in embedding the desired attributes into curriculum. Hence, it helps graduates to improve their employability based on the employers' needs. The consequence of the improvement will help to increase the employment rate among physics graduates. On the other hand, the study will also help to understand the differential perceptions among the three aspects in order to minimize the gap between needs, taught and learned of the generic attributes.

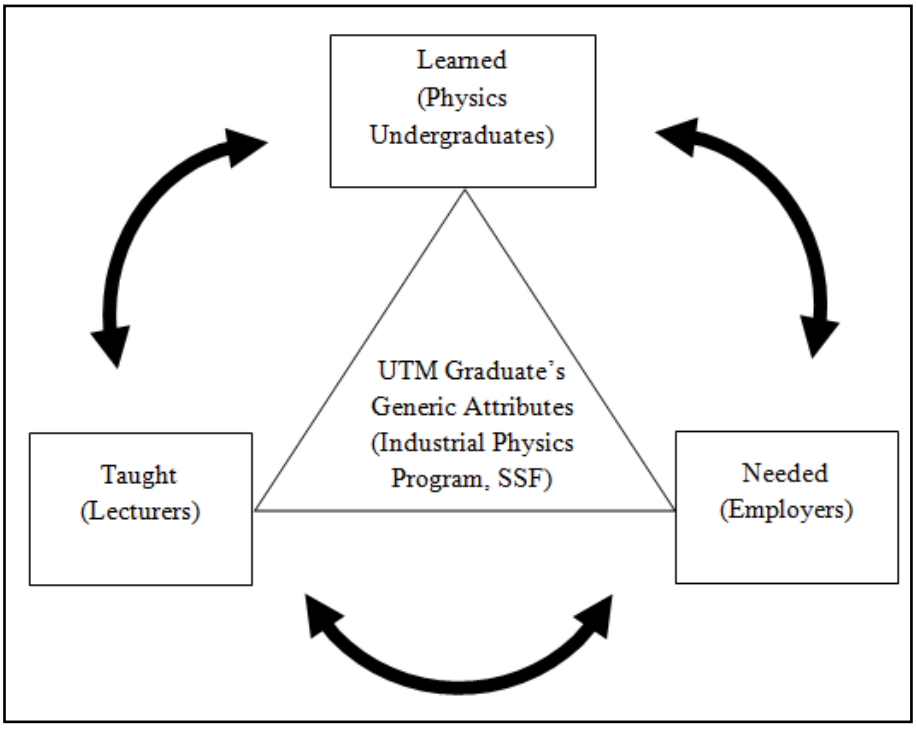

Figure 1: An overview framework relating the aspect in this study.

Specifically, the study seek to address the following questions

1. What is the perception of physics graduates on the development of their generic skill through the program?
2. What is the perception of physics lectures on the development of physics graduates' generic skill through the program?
3. What is the perception of employers on the generic skills possessed on physics graduates?

4.0 RESEARCH METHODOLOGY

The sampling design consists of the sample selection of the study who was the Physics undergraduates and Physics lecturers in Faculty of Science, UTM, and the employees who had employed Physics graduates. Cross sectional study will be conduct to answer the research questions. Questionnaires and interviews were adopted as the data collection method in this study.

4.1 QUESTIONNAIRE

The initial questions for the questionnaire was adapted from the works of several past researchers (Coll et al, 2002; Martin et al, 2008; O'Byrne and Mendez, 2008; and Zegwaard and Hodges, 2003) who have done the study on the subject matter. The questions were then amended and reworked to suit the context of this study. The questionnaire used was validated by two content experts and the Alpha Cronbach reliability test result was 0.96 964 which is above the benchmark 0.75 (Perry et. al., 2007) and is reliable for further analysis..

Self-administered technique was employed in administering the questionnaire, where researcher will be on site, to distribute and to collect the completed forms. According to Best and Kahn (1986), self administer of questionnaire will have the opportunity to establish rapport, explain the purpose of the study and the meaning of the test item that may not be clear. This will help to increase the usable rate and respond rate of the questionnaire.

As the result, 104 Physics undergraduates and 27 Physics lecturers from Faculty of Science, UTM were participated in the questionnaire section. The respondent rate was 75% for Physics undergraduates and 69% for Physics lecturers. Respondents were required to identify the development level of seven generic attributes through Physics studies on a semantic scale range from 1 to 7 between two extreme choices where 1 indicated as the least developed and 7 indicated the most developed. The seven generic attributes are communication skill (CS), critical thinking and problem solving skill (CTPS), team working skill (TW), lifelong learning and information management skill (LL), entrepreneurship skill (ES), leadership skill (LS) and, ethic and integrity skill (ET). Besides that, respondents were also asked to rank the seven generic attributes from 1 to 7 according to their perception with 1 is equal to first priority and 7 is the least priority.

4.2 INTERVIEW

The purpose of semi-structured interview was adopted in this research is to elicit the information from employees regarding the generic attributes performed and needed by Physics graduates. Employees were identifying as the key informants among the three parties in this study because they have special perceptions on the needs of generic attribute possessed on physics graduates in workplace. The interview questions were adopted from Sharma et al (2008) and item were selected according to the appropriate of this study. The interviews were recorded and summarized. The data was analyzed by comparing the responses for each question both across the interviewees and through each interview in order to identify key categories and features. As the result, interview data of three employers who had employed Physics graduates were collected.

5.0 RESULT

The result collected were interpreted and explained into two sections. First, generic attributes development level among graduates and lecturers were evaluated using Mann-Whitney U test. Second, Wilcoxon signed ranks test were used to investigate the priority ranking of generic attributes among graduates and lecturers. At the same time, interview data collected from employers were categories and key features were identified to further reveal the perception from employers.

Generic Attributes Development Level

A list of UTM's undergraduates generic attributes were presented in the questionnaire and respondents were asked to indicate the level of development of each generic attributes on a semantic scale range from 1 to 7 where 1 indicates least developed and 7 indicates most developed. The scales using in this section is an ordinal scale. Differences of two samples and direction of differences can be determined using ordinal measurement. However, ordinal measurements are not able to determine the magnitude of the differences between two samples. Since the mean and distance of an ordinal data is not well defined, calculation of a sample mean and deviations is prohibited. (Frederick & Larry, 2004). In order to understand the differences of respondents' perceptions, Mann-Whitney U test with significance level, $p<0.05$ had been conducted. Mann-Whitney test is to use the ordinal data from two separate samples to evaluate the difference between two samples. (Frederick & Larry, 2004).

As mention earlier, one of the purposes of this study is to investigate the perception differences among undergraduates and lecturers. As the Mann-Whitney U tests result show in table 1, there were a significance difference between lecturers and undergraduates' perception in the development level of communication skills (CS), team working skills (TW), lifelong learning and information management skills (LL), leadership skills (LS) and ethic and integrity skills (ET). Lecturers had suggested a higher level of development in these attributes compared to undergraduates. This implied that undergraduates do not develop the mention generic attributes as much as taught by lecturers. However, the results in table 4.5 showed that undergraduates and lecturers do not have significant difference in the level of development for critical thinking and problem solving skills (CTPS), and entrepreneurship skills (ES) with $p>0.05$. Thus, revealed that undergraduates had learnt the skills as embedded by lecturers through Physics studies.

Table 1: Mann-Whitney tests on generic attributes development level based on respondent categories. (Undergraduates versus lecturers).

Statistic Comparison (Undergraduates versus Lecturers)						
Generic Attributes	No of Participant		Mean Rank		Mann-Whitney U	Asymp. Sig (2-tailed)
	Undergraduates	Lecturers	Undergraduates	Lecturers		
CS	104	27	405.35	665.66	29736.50	0.000*
CTPS	104	27	322.54	349.02	32262.00	0.131
TW	104	27	174.14	285.04	5505.00	0.000*
LL	104	27	174.29	284.46	5551.50	0.000*
ES	104	27	67.18	61.44	1281.00	0.466
LS	104	27	115.47	193.26	2281.00	0.000*
ET	104	27	183.75	248.02	8503.50	0.000*
*significant at $p<0.05$						

However, according to the interview data of employers, Physics graduates only performed their generic attributes as normal. For an example, they do performed critical thinking and problem solving skills in translating customer requirement into ideas and implementation of ideas, product inspection, failure analysis and trouble-shooting. As well as communication skills during conversation, meeting, discussion and so on.

> *……demonstrated those generic attributes as a normal human did……critical thinking skills to translate the requirements into ideas…….problems solving skills to solve problems that faced during implementation of the ideas……*

Employers do suggested that lifelong learning and information management skills are needed to be developed more in Physics study. It was an important aspect for the employee to perform continuous learning as graduates can only gained basic knowledge from university or school.

> *……physics graduates could become better if they have this "Information management and lifelong learning skill". Knowledge from physics course is not enough for what a Physics graduate work as. It's only provides you the basic to learn the profession in your field.*

According to him, the level of development for team working skills is low as well as the ability to listen, respond and present orally. Thus, Physics graduates needs to have lifelong learning and information management skills to help them perform better.

5.1 Priority Ranking of Generic Attributes

The respondents were required to identify the importance of each generic attribute by placing number from 1 to 7. 1 indicated as the first priority while 7 indicated as the last priority. Initially, frequency percentage distribution tables were used to illuminate the distribution scores of each priority scale. Because the table organizes the scores, thus it is very convenient to comprehend the results of the priority ranking for each generic attributes among the respondents quickly. (Frederick & Larry, 2004).

Table 2 is a generic attributes priority ranking frequency percentage distribution table from 104 undergraduates. 37.5% of undergraduates rank the communication skills (CS) as the first priority. As it goes through, critical thinking and problem solving skills (CTPS) was observed to be ranked in second priority by majority of undergraduates ranked which is equal to 37.5%. Followed by a majority of 38.5% ranked team working skills (TW) as third priority, 43.4% ranked lifelong learning and information management (LL) as forth priority. 39.4% out of 104 undergraduates ranked entrepreneurship skills (ES) as fifth priority. Majority undergraduates ranked leadership skills (LS) as sixth priority which equal to 38.5%. Lastly, 44.2% of them ranked ethic and integrity skills (ET) as the least priority.

Table 2: Generic attributes ranking base on frequency percentage (Undergraduates).

Matrix table : Generic Attribute and Priority Ranking (undergraduates)							
Rank	CS%	CTPS%	TW%	LL%	ES%	LS%	ET%
1	37.5	25.0	12.5	6.7	2.9	6.7	8.7
2	19.2	37.5	18.3	6.7	4.8	7.7	5.8
3	11.5	16.3	38.5	14.4	13.5	2.9	2.9
4	7.7	5.8	13.5	43.3	15.4	11.5	2.9
5	1.9	5.8	8.7	14.4	39.4	15.4	14.4
6	10.6	5.8	2.9	9.6	11.5	38.5	21.2
7	11.5	3.8	5.8	4.8	12.5	17.3	44.2

A total of 27 lecturers had participated in the questionnaire and their perception on the priority ranking of generic attributes had been collected. Each priority ranking score of generic attributes were accumulated and presented in table 3 as frequency percentage. For communication skills (CS), 44.4% of lecturers ranked it as first priority while majority of them (51.9%) ranked critical thinking and problem solving skills (CTPS) as second priority.

As going through table 3, majority of lecturers (55.6%) ranked team working skills (TW) as third priority and 33.3% of lecturers ranked lifelong learning and information management skills (LL) as forth priority. For entrepreneurship skills (ES), none of the lecturers ranked it as first, second and third priority. Majority of the lecturers or 40.7% of them ranked entrepreneurship skills (ES) as least priority. Leadership skills (LS) were ranked in fifth priority by majority of the lecturers (33.3%). Lastly, 40.7% of lecturers ranked ethic and integrity skills (ET) as least priority.

Table 3: Generic attributes ranking base on frequency percentage (Lecturers).

Matrix table : Generic Attribute and Priority Ranking (lecturers)							
Rank	CS%	CTPS%	TW%	LL%	ES%	LS%	ET%
1	37.0	48.1	3.7	3.7	0.0	0.0	7.4
2	44.4	51.9	0.0	3.7	0.0	0.0	0.0
3	18.5	0.0	55.6	7.4	0.0	3.7	14.8
4	0.0	0.0	25.9	33.3	7.4	22.2	11.1
5	0.0	0.0	11.1	25.9	25.9	33.3	3.7
6	0.0	0.0	3.7	18.5	25.9	29.6	22.2
7	0.0	0.0	0.0	7.4	40.7	11.1	40.7

Although the frequency percentage distribution tables may reflect the distribution of scores, but it did not provide information about the significance of the difference regarding the rank of priority for each generic attributes. Thus, Wilcoxon signed-ranks test with significant level p=0.05 was used to evaluate the difference between two generic attributes scores from a related sample. (Frederick & Larry, 2004).

The priority ranking comparison of generic attributes among 104 undergraduates and 27 lecturers were demonstrated in Table 4. The results showed that the ranking position for communication skills (CS) is not significant difference from critical thinking and problem solving skills (CTPS). Thus, both skills were to be ranked in the same position as first priority by undergraduates. The ranking were significant followed by team working skills (TW),

lifelong learning and information management skills (LL), entrepreneurship skills (ES), leadership skills (LS), and the least priority was ethic and integrity skills (ET).

Similarly to undergraduates' perception, the priority ranking difference between communication skills (CS) and, critical thinking and problem solving skills (CTPS) among lecturers is not significant with $p>0.05$. Both of undergraduates and lecturers ranked communication skills (CS) and, critical and problem solving skills (CTPS) in the highest priority. However, according to lecturers, both leadership skills (LS) and, ethic and integrity skills (ET) were ranked as least priority which is different from undergraduates where leadership skills (LS) were ranked higher than ethic and integrity skills (ET).

Table 4: Generic attributes ranking base on Wilcoxon signed ranks test,

Generic Attributes	Comparison	Undergraduates		Lecturers	
		Wilcoxon, Z	Asymp. Sig (2-tailed)	Wilcoxon, Z	Asymp. Sig (2-tailed)
CS	CS – CTPS	-1.529	0.126	-1.461	0.144
CTPS	CTPS – TW	-2.679	0.007*	-4.488	0.000*
TW	TW – LL	-3.849	0.000*	-2.726	0.006*
LL	LL – ES	-2.985	0.003*	-3.674	0.000*
ES	ES – LS	-2.014	0.044*	-2.145	0.032*
LS	LS – ET	-2.283	0.022*	-0.590	0.556
ET	-	-	-		
*significant at $p<0.05$					

The ranking of generic attributes were supported by employers and they had identified that the main function of an employee is actually to solve problems thus critical thinking and problem solving skills is the first priority that a good employee should perform. On the other hand, employers believed that the company rules and regulations will help in preventing ethic and integrity problem, hence ethic and integrity skills were ranked in the least priority.

> *Basically, a good employee solves problems. We have rules and regulations. So, ethics and integrity is not a concern. ……we have marketing department in business things…….with better critical and problem solving skills, employee can better design and develop circuits that attract customer's interest……*

On the other hand, entrepreneurship skills were in least priority as well employers point out that every company will have their own marketing or business department to identify and work for business opportunity. Thus, it will not be a concern for physics graduates to possess entrepreneurship skills.

6.0 IMPLICATION

The data and results collected from the questionnaire and interview had provided a broad perspective about the generic attributes developed through Physics studies. Undergraduates do developed their critical thinking and problem solving skills (CTPS) as embedded by lecturers as well as appreciated and valued by employers. However, employers do concern about the development level of team working skills (TW) and communication skills (CS) among Physics graduates. Thus, employers wish that Physics graduates should possessed lifelong learning and information management skills (LL) that would help them continue learning and

perform better in the future. Besides that, there was a significant development gap between lecturers and undergraduates. Much of the skills (communication skills, team working skills, lifelong learning and information management skills, leadership skills, ethic and integrity skills) that were embedded by lecturers were not learn by the undergraduates hence causing a significant different on their level of development between taught and learn. This implied that, more effort should be pay to increase the development level of generic attributes.

On the other hand, there was a positive perspective from this study. The three parties in this study seem to have similar perception on the priority of the generic attributes. Critical thinking and problem solving skills (CTPS) were their priority in learning, teaching and requirement. Hence, it can be suggested that all the three parties are in common direction to achieve the common goals but there are still room for improvement as gap exist on the development level of generic attributes among them.

7.0 CONCLUSION

The results of the study showed that Physics undergraduates, Physics lecturers and employers are agree on the needs of generic attributes development through Physics studies. However in order to reach the common goals, more effort should be put to minimize the gap between needs, taught and learned of the generic attributes. By reaching the goal, it proved that Physics studies will help equip graduates with several of skills besides knowledge. With the generic attributes embedded in graduates, it also helps to reduce the unemployment rate among Physics graduates. Thus, Physics graduates will be able to contribute to the nation wealth creation.

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