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Assessing Student Programming Skills and Area of Interests in the Final Year Project

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Abstract: Final Year Project (FYP) is an essential ingredient of an undergraduate programme as it creates a platform for students to strengthen their problem-solving and research skills. However, in the case of Information Technology (IT) programme, students are lack of knowledge in choosing the most suitable area of interest that complements their programming skills. Also, the issues arise, such as: "How to select the most suitable area of interest for the final project?" and "Do programming skills offer benefits in choosing the area of interest for the final project?". This paper proposes a method to assess the meaningful relationship between a student programming skill and the area of interest for the final year project with the aided of a user study by capturing students' perception on these two qualities in selecting their final year project. The obtained correlation between the two qualities, which is the key contribution of the paper, creates a platform for further research into developing a recommendation system that can assist final year projects students in selecting the most suitable research area for their FYP.

Keywords: Final Year Project, Statistical Analysis, User Study

1. INTRODUCTION

The final year project (FYP) is an important component of the undergraduate course, regardless of the programme [1]. FYP modules aim to establish a learning environment which fosters collaboration and interaction between supervisors and students. This develops a sense of co-operation and belonging within the student, positively impacting student engagement [1]. In addition, according to [2], the FYP is a performance-based course that gives an important indicator regarding the readiness of the undergraduate student to graduate as well as the perceived quality of the program offered by the university.

In some practices, final projects are offered by academics or the project supervisors for students to choose. However, this is not the best way to see the potential of the student that have specific skills which may be in line with other research areas. Additionally, the student may also not aware of the area of interest that suits their skills. As reported in [3], they claimed that to achieve the best experience from FYP projects, the student skills, interests and abilities should ideally be matched with the chosen research topic. This is necessary to avoid the student from becoming demotivated in pursuing their project. Therefore, the current paper aims to focus on understanding the relationship between the area of interest and student skills.

At our institution (UiTM Perlis, Malaysia), the FYP is also one of the requirements to be fulfilled by the Bachelor of Information Technology (CS240) degree students in order to graduate. The FYP is divided into two parts: proposal and project construction. The proposal part is vital as students must discover the project problem area, its significance, scope and objectives [4]. The student may choose his or her problem area based on their interests or may consult with a possible supervisor from a pool of faculty lecturers to determine a proper problem area.

Nevertheless, as in the current situations, almost all final year students are unsure whether the chosen area of interest for the project meets appropriately with their programming skills. To the best of the authors' knowledge, the research that investigates the relationship between the area of interest of the final year project and the final year student's programming skills in selecting their final year project. has not been adequately discussed

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in the literature. In this paper, we propose a method to tackle this issue. With the aided of a user study, we provide a pathway to assess the meaningful correlation between the area of interest for FYP and programming skills. In this paper, the user study is designed to capture student perceptions of both qualities for the Bachelor of Information Technology degree students at UiTM Perlis, Malaysia. The outcome of this research is also applicable for final year students from other higher education institutions that are taking related or similar courses.

This paper is organised as follows; the first section discusses the background to the final year project, students' skills, area of interest and user studies. This is followed by the second section that introduces a user study-based approach to assess the area of interest for FYP and programming skills. In the third section, the process to investigate the relationship between the area of interest for FYP and programming skills are carefully explained. Finally, the fourth section presents the conclusions and future works.

2. BACKGROUND

In this section, we briefly present background in respect to the final year project, students skills, area of interest and user studies.

A. Final Year Project

Final year project creates an opportunity for students to work together with professionals, employing the skills and knowledge acquired by the students during their three or four years of studies. Additionally, as discussed in [5], the system resulting from the adaptation to the European Higher Education Area, FYP has become an integral part of the program curriculum. It must be equipped towards the development of research or innovation in the student professional field. Since this project is considered the most complete and essential evidence of research or innovation presented by the students, it is planned to play an essential role in their final grade. The FYP is, therefore, a vital ingredient of the degree programme and, for many, a point of intense interest when it comes to attempting to enhance the quality of education [6].

B. Student Skills

Students' skills play a vital role in the success of the final year project of which among them is the problem-solving skills which is a cognitive process [7]. The skill is crucial for students to identify, categorise and define a specific problem or issue raised in their final year project. Also, the problem-solving skill is required in analysing and evaluating the problem, and in generating and choosing the best solution to the identified problem. In general, problem-solving skills include creative and innovative thinking to find new methodologies to analyse the problem, logical skills to study the effects of a specific result, and reasoning skills to consider and compare different potential solutions. Meanwhile, in the study by [8] despite vast differences in final project genres, several skills such as. critical thinking, communication, writing and time management are essential and can be considered as standard components to the assessment of different project genres.

Concentrating on Information Technology (IT) project, computer programming needs skills in critical thinking, problem-solving, computational thinking and new system designs. The demand for computational thinking and advancements in the programming skills of individuals is crucial and has lately received much attention [9]. In the study by [10], they found that the average programming ability score of first-year students was approximately 23 out of 110. Additionally, in early programming courses, the decline rate is found to be between 30 and 40 per cent, which shows how students struggle with programming. This criterion is essential to consider when students need to select a suitable area of interest for their final year project.

C. Area of Interests

The current view of FYP is probably much more extensive. It is seen as an essential learning experience in itself. Although it does provide experience in research and inquiry skills, it also produces an opportunity to tackle problem areas that have both 'real world' and purely academic relevance [5]. Also, the choices as to the kind of FYP they undertake are essential as students have different motivations and career aspirations. According to [11], they claimed that a more manageable but equally robust approach is required in the design and evaluation of FYP to meet the needs of students from various subject areas and types of institution. The student may select a project from a list offered by their supervisor or suggest their topic based on their interest [6]. Nevertheless, it may be helpful to students if a range of options is being offered which provide them with an opportunity to develop knowledge and critical skills in their area of interest [11].

D. User Studies

A user study is one of the methods that can be used to convey design research. A user study allows researchers to identify specific variables that are interesting and observe the impact on the result of varying those factors [12]. For example, a survey of 168 Information Systems Development (ISD) professionals was conducted to assess a combination of both user knowledge of Information system (IS) development [13]. The results

show that both users' knowledge of IS development and IS developers' knowledge of application domains have meaningful influences on project performance. Also, in [14], they conducted a user study to assess how users perceive the interpretability and complexity of fuzzy logic systems. The user study is implemented at Fuzz-IEEE 2017 conference, which was held in Naples, Italy. The sample of participants was selected from a range of academics (from doctoral students to full Professors). In this paper, a user study is proposed to assess the meaningful correlation between students programming skills and the area of interest for their final year project, for the students from the *Information Technology (IT) course based at* UiTM Perlis, Malaysia.

3. A User Study Approach

In this section, we propose a user study approach to assess a meaningful correlation between student programming skills and the area of interest for the final year project. Specifically, we attempt to provide the insight of these two qualities into the final year student in the program Bachelor of Information Technology (CS240), in UiTM, Perlis, Malaysia.

However, to create a user study to evaluate both qualities is not an easy task as it concerns the subjective view of students. Hence, we have proposed the way of producing this study, as explained in the following subsection. Note that this approach has aspired from the studies conducted by [14] and [15].

A. Step 1 – Reviewing the Literature

We begin by thoroughly reviewing the literature that concentrates on the problems and issues to student skills and the area of interest, particularly concerning the final year project.

B. Step 2 – What are the questions? How to ask people?

Intuitively, one may say it is a straight forward task to create the questions in the user study. However, we must be careful in creating the questions as it involves the subjective view of people for a particular question. Also, we need to be very clear about the expected result that we demand from people.

In this section, the key challenges arise, include: (i) How can we ask the final year student? and (ii) What are the questions to be asked as we aimed to capture student's perception of the area of interest and their programming skills?

C. Step 3 – Online Survey and Google Form

Following the challenge discussed earlier, we decided to use an online survey in our study in order to capture student perception on their programming skill and the area of interest. This is because this platform is very convenient and easy to get the number of participants.

In their study, [14] found that people feel much more confident in giving rankings rather than giving numerical values. Therefore, we also asked students to provide a rank for the questions of programming skills and the area of interest. For example, students may provide the rank for their programming skill JAVA from 1 to 5, indicating 5 is very confident, and 1 is least confident.

Specifically, we used a google form platform to produces the online survey because it is simple to create and use. Additionally, this platform is secure, freely available and can be accessed with Gmail account. Figures 1 to 3 show the interface of the survey generated in the google form, namely the main interface, area of interest and programming skills questions, respectively.

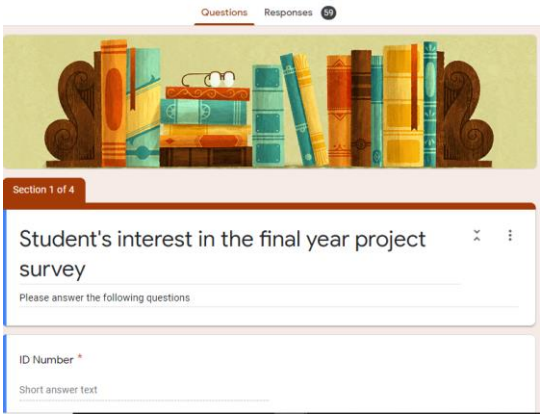

Figure 1. Google Form Survey: Main Interface

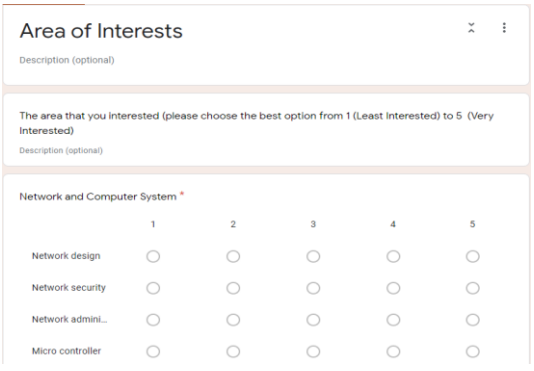

Figure 2. Google Form Survey: Area of Interest

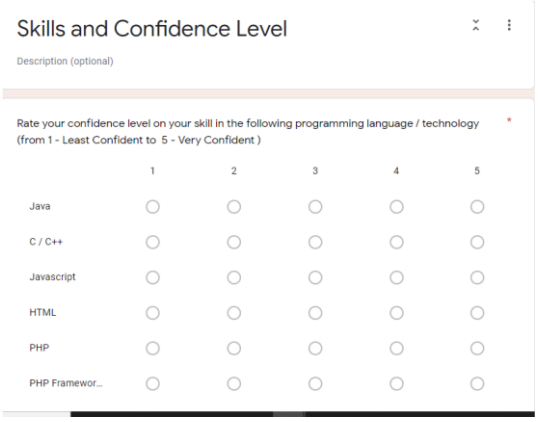

Figure 3. Google Form Survey: Programming Skills

4. Experiment and Results

This study aims to investigate the relationship between the area of research interest and student programming skill, as obtained in the proposed user study. The analysis process consists of two main steps: (i) descriptive analysis of the survey data; and (ii) statistical analysis of the area of interest and programming skills.

A. Descriptive Analysis

We received responses from 59 participants at University Technology MARA, Perlis Branch, who answered this survey. Moreover, most of the participants are from the final year students in the Bachelor of Information Technology (CS240) programme. From this data, we first summarise and describe the survey data in a meaningful way using basic frequency tables based on the area of interest and programming skills.

1) Area of Interests

The first question in this survey cover about the area of interest for the final year project, particularly for Bachelor of Information Technology students. That includes five key areas, namely *Network and Computer System*, *Multimedia*, *Web Application*, *Artificial Intelligent* and *Ubiquitous Computing*. Detail description of each area is outlined in the following subsection.

a) Network and Computer System

Table I shows the result of rankings for the area of interest in the *network and computer system*. The last column summarises the entire table, providing the average rank. For the case of *network and computer system*, most of the participants chose *Network security* to be most interest than *Network design*, *Network administration* and *Microcontroller*, with the average rank is 2.78. The results also show that the participants chose equally interest in *Network design* and *Microcontroller* with the average rank is 2.69.

TABLE I FREQUENCY OF THE RANKING FOR THE AREA OF INTEREST IN NETWORK AND COMPUTER SYSTEM

Area of Interest	Rank					Average Rank
	1	2	3	4	5	
Network design	8	17	20	13	1	2.69
Network security	7	14	25	11	2	2.78
Network administration	7	15	27	10	0	2.68
Microcontroller	9	13	27	7	3	2.69

To summarise this result, Figure 4 presents a clear overview of the area *Network and Computer System* that are most interested in the participants' point of view.

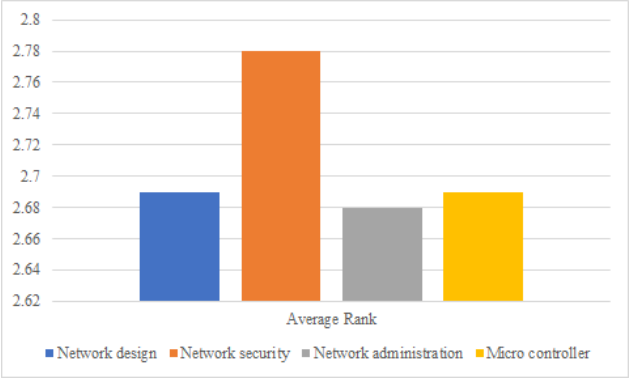

Figure 4. Participants ranked the area of interest in Network and Computer System

b) Multimedia

Table II shows the result of rankings for the area of interest in the *multimedia*. Likewise, the last column summarises the entire table, providing the average rank. For the case of *multimedia*, most of the participants chose *Interactive multimedia* to be most interest than *User Interface design*, *Multimedia Courseware* and *Augmented reality*, with the average rank is 3.58. The results also showed the similarity of responses from participants as there were only slight differences between the average rank for each choice. In general, the result also confirmed that participants have rate more than average in the area of interest in *multimedia* as they produce more the average rank (≥ 3) for each option.

TABLE II FREQUENCY OF THE RANKING FOR THE AREA OF INTEREST IN MULTIMEDIA

Area of Interest	Rank					Average Rank
	1	2	3	4	5	
Interactive Multimedia	4	4	18	20	13	3.58
Multimedia Courseware	3	9	21	17	9	3.34
User Interface design	3	6	16	23	11	3.56
Augmented Reality	5	5	26	15	8	3.27

To summarise this result, Figure 5 presents a clear overview of the area of interest in *Multimedia* that is most interested in the participants' point of view.

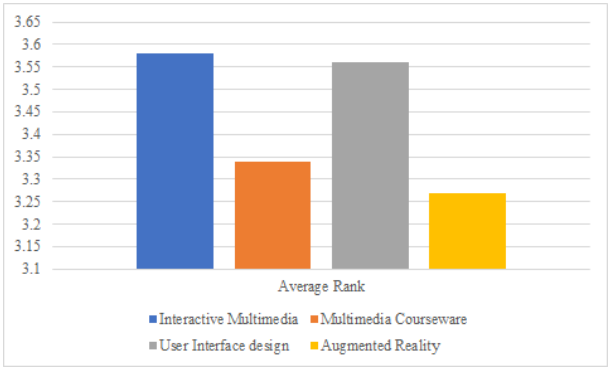

Figure 5. Participants ranked the area of interest in Multimedia

c) *Web Application*

Table III shows the result of rankings for the area of interest in the *web application*. Again, the last column summarises the entire table, providing the average rank. For the case of the *web application*, most of the participants chose the *Web information system* to be most interest than *E-Learning*, *E-Commerce System* and *Decision support system*, with the average rank is 3.54. The results also showed the similarity of responses from participants as there were only slight differences between the average rank for each choice. Likewise, overall, the result confirmed that participants have rate more than average in the area of interest in *Web Application* as they produce more the average rank (≥3) for each option.

TABLE III FREQUENCY OF THE RANKING FOR THE AREA OF INTEREST IN WEB APPLICATION

Area of Interest	Rank					Average Rank
	1	2	3	4	5	
Web Information System	2	3	23	23	8	3.54
Decision Support System	4	7	31	12	5	3.12
E-Learning	3	7	22	19	8	3.37
E-Commerce System	4	7	26	15	7	3.24

To summarise this result, Figure 6 presents a clear overview of the area of interest in *Web Application* that is most interested in the participants' point of view.

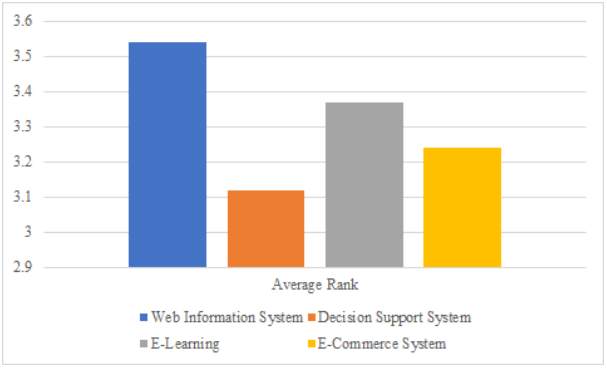

Figure 6. Participants ranked the area of interest in Web Application

d) *Artificial Intelligent*

Table IV shows the result of rankings for the area of interest in the *Artificial intelligent*. The last column summarises the entire table, providing the average rank. For the case of *Artificial intelligent*, most of the participants chose the *Expert system* to be most interest than *Machine learning*, *Natural Language Processing* and *Neural network*, with the average rank is 2.92. The results also showed the similarity of responses from participants as there were only slight differences between the average rank for each choice. Overall, the result verified that participants have less interest in the area of Artificial intelligent as they produce less than the average rank (< 3) for each option.

TABLE IV FREQUENCY OF THE RANKING FOR THE AREA OF INTEREST IN ARTIFICIAL INTELLIGENT

Area of Interest	Rank					Average Rank
	1	2	3	4	5	
Expert System	4	15	26	10	4	2.92
Neural Network	6	14	30	5	4	2.78
Machine Learning	4	18	21	12	4	2.9
Natural Language Processing	4	15	29	7	4	2.86

To summarise this result, Figure 7 presents a clear overview of the area of interest in Artificial Intelligent that are most interested in the participants' point of view.

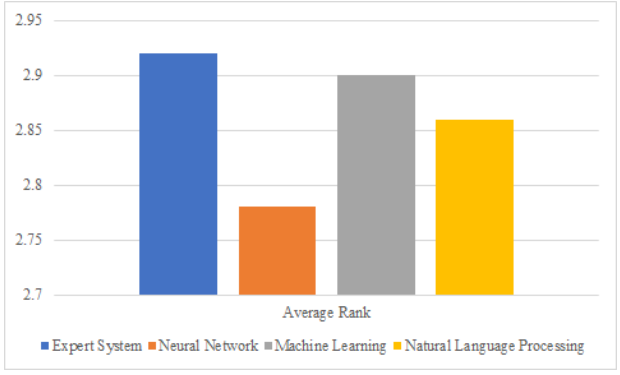

Figure 7. Participants ranked the area of interest in Artificial Intelligent

e) Ubiquitous Computing

Table V shows the result of rankings for the area of interest in *Ubiquitous computing*. The last column summarises the entire table, providing the average rank. For the case of *Ubiquitous computing*, most of the participants chose *Mobile Application* to be most interest than *Mobile Learning*, *Internet of Things* and *Mobile Games*, with the average rank is 3.59. The results also showed the similarity of responses from participants as there were only slight differences between the average rank for each choice. In fact, participant ranked equally interest in *Mobile learning* and *Internet of things* with the average rank is 3.49. Likewise, the result confirmed that participants also rate have more than average in the area of interest in *Ubiquitous computing* as they produce more the average rank (≥ 3) for each option.

TABLE V FREQUENCY OF THE RANKING FOR THE AREA OF INTEREST IN UBIQUITOUS COMPUTING

Area of Interest	Rank					Average Rank
	1	2	3	4	5	
Mobile Application	3	4	18	23	11	3.59
Mobile Learning	4	5	18	22	10	3.49
Mobile Games	7	7	15	16	14	3.39
Internet of Things	4	6	21	13	15	3.49

To summarise this result, Figure 8 presents a clear overview of the area of interest in Ubiquitous Computing that is most interested in the participants' point of view.

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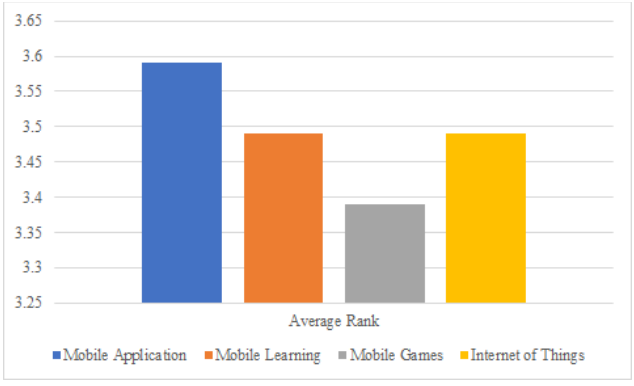

Figure 8. Participants ranked the area of interest in Ubiquitous Computing

In general, we can obviously see that most of the participant are less interest in the area *of Network and Computer System* and *Artificial Intelligent* for their final year project. This is due to the result of the average rank that revealed with only less than average (< 3) that rate for them. Therefore, only the area of *Multimedia, Web Application* and *Ubiquitous computing* will be further analysed together with programming skills to obtain a meaningful correlation between them.

2) Programming Skills

The second question in this survey is to acquire the confidence level of their programming skills from final year students of CS240 programme. Eight essential programming skills will be asked to the student, namely *Java, C, Javascript, HTML, PHP, PHP Framework, Phyton* and *.Net application*.

TABLE VI FREQUENCY OF THE LEVEL OF CONFIDENT RANKING FOR THE PROGRAMMING SKILL

Area of Interest	Rank					Average Rank
	1	2	3	4	5	
Java	1	15	33	7	3	2.93
C	0	9	31	15	4	3.24
Javascripts	3	15	27	14	0	2.88
HTML	0	7	13	30	9	3.69
PHP	8	8	20	19	4	3.05
PHP Framework	13	17	21	6	2	2.44
Python	8	25	21	5	0	2.39
.NET	19	21	15	3	1	2.08

Table VI shows the frequency of the level of confident ranking for the programming skills from participants. In general, we can see that all students have an average on the confidence level of their programming skills. The higher the confidence level on the programming skills was *HTML* with the average rank is 3.56. To summarise this result, Figure 9 presents a clear overview of the confidence level for programming skills from the participants' point of view.

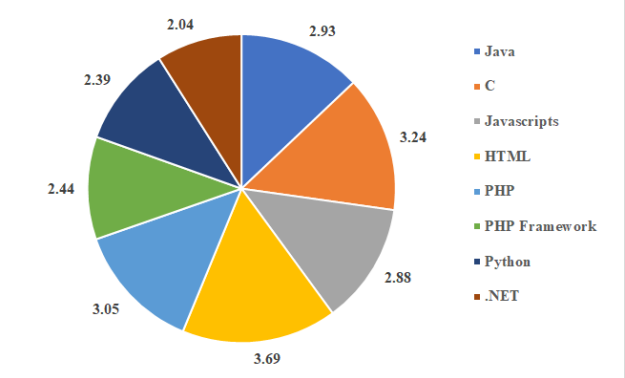

Figure 9. Participants ranked the level of confident in Programming Skills

From these results, some questions arise which include: (i) What is the significant correlation between programming skills and the area of interest? (ii) Does the programming skill of *HTML* only have a significant correlation with the area of interest? and (iii) How may the correlation between less confident in programming skills and less interest in the area affect the final year project?

Thus, while weaker, these relationships also should be considered in order to investigate the significance of the relationship between the area of interest and programming skills.

B. *Correlation between the Area of Interest and Programming Skills Analysis*

We have investigated the significance of the relationships between the area of interest and programming skills for final year project using Pearson's correlation coefficient (r) [16]. The latter statistically discover how influential a relationship is between two variables, where $+1$ indicates a strong positive relationship and -1 indicates a strong negative relationship [17]. Note that for the case of the area of interest, only the area of *Multimedia*, *Web Application* and *Ubiquitous computing* were selected to investigate the significant correlation with programming skills. This is due to the fact that only these three areas were more than average interest ranked by all participants.

Tables VII, VIII and IX show a summary of the statistics for the area of interest (*Multimedia*, *Web Application* and *Ubiquitous computing*) and programming skills that were computed using Pearson's correlation coefficients (r). The last row summarises the entire table, providing the mean for each column.

TABLE VII PEARSON CORRELATION COEFFICIENT (R) BETWEEN AREA OF INTEREST IN MULTIMEDIA AND PROGRAMMING SKILLS

Programming Skills	Multimedia							
	Interactive Multimedia		Multimedia Courseware		User Interface design		Augmented Reality	
	r	*p*-value	*r*	*p*-value	*r*	*p*-value	*r*	*p*-value
Java	0.139811	0.29	0.2652	0.04	0.2043	0.12	0.2392	0.06
C	0.23155	0.07	0.3274	0.01	0.2666	0.04	0.4553	0.00
Java Script	0.16755	0.20	0.2574	0.04	0.3078	0.01	0.2666	0.04
HTML	0.2707	0.03	0.3309	0.01	0.4239	0.00	0.3076	0.01
PHP	0.2346	0.07	0.3522	0.00	0.3588	0.00	0.2696	0.03
PHP Framework	0.2343	0.07	0.352	0.00	0.3274	0.01	0.3624	0.00
Python	0.1253	0.34	0.3124	0.01	0.2157	0.10	0.2837	0.02
.NET	0.161	0.22	0.3188	0.01	0.3187	0.01	0.3233	0.01

Mean	0.1956	0.16059	0.3145	***0.0194**	0.3029	***0.0039**	0.2997	0.191

In general, for the case of the correlation between the area of interest in Multimedia and programming skills, as shown in Table VII, the result showed a positive correlation (+) between them. However, only *multimedia courseware and user interface design* have a significant correlation with the programming skill as the mean of the *p*-value is less than 0.05, with the value of 0.0194 and 0.0390, respectively.

TABLE VIII PEARSON CORRELATION COEFFICIENT (*R*) BETWEEN AREA OF INTEREST IN WEB APPLICATION AND PROGRAMMING SKILLS

Programming Skills	**Web Application**							
	Web Information System		**Decision Support System**		**E-Learning**		**E-Commerce System**	
	r	***p*-value**	***r***	***p*-value**	***r***	***p*-value**	***r***	***p*-value**
Java	0.3774	0.0032	0.1875	0.1551	0.2794	0.0321	0.2252	0.0864
C	0.3411	0.0082	0.2095	0.1112	0.2474	0.0588	0.2644	0.043
Java Script	0.4478	0.0004	0.3394	0.0086	0.3735	0.0036	0.3918	0.0021
HTML	0.4462	0.0004	0.349	0.0068	0.4712	0.0002	0.3649	0.0045
PHP	0.4371	0.0005	0.3399	0.0084	0.5276	1.76E-05	0.3546	0.0059
PHP Framework	0.3551	0.0058	0.3368	0.0091	0.4799	0.0001	0.3118	0.0162
Python	0.1932	0.1426	0.1132	0.3933	0.0286	0.8296	0.1106	0.4041
.NET	0.1803	0.1719	0.173	0.1901	0.1401	0.2899	0.2191	0.0954
Mean	0.3473	***0.0416**	0.256	0.1103	0.3185	0.1518	0.2803	0.0822

Likewise, for the case of the correlation between the area of interest in *Web application* and programming skills, as shown in Table VIII, the result also showed a positive correlation (+) between them. However, only the *web information system* has a significant correlation with the programming skills as the mean of the *p*-value is less than 0.05, with the value of 0.0416.

TABLE IX PEARSON CORRELATION COEFFICIENT (*R*) BETWEEN AREA OF INTEREST IN UBIQUITOUS COMPUTING AND PROGRAMMING SKILLS

Programming Skills	**Ubiquitous Computing**							
	Mobile Application		**Mobile Learning**		**Mobile Games**		**Internet of Things**	
	r	***p*-value**	***r***	***p*-value**	***r***	***p*-value**	***r***	***p*-value**
Java	0.2966	0.0225	0.3528	0.0061	0.3874	0.0024	0.3074	0.0179
C	0.1401	0.2898	0.2613	0.0457	0.3593	0.0052	0.2778	0.0331
Java Script	0.263	0.0441	0.3319	0.0102	0.3622	0.0048	0.2711	0.0378
HTML	0.3359	0.0093	0.4311	0.0007	0.3939	0.002	0.1643	0.2138
PHP	0.223	0.0896	0.3114	0.0154	0.4183	0.001	0.2769	0.0338
PHP Framework	0.2303	0.0797	0.3036	0.0194	0.4257	0.0008	0.2247	0.0871
Python	0.0271	0.8382	0.1467	0.2676	0.224	0.0881	0.2766	0.0343
.NET	-0.01658	0.9008	0.1068	0.4207	0.2741	0.0357	0.2341	0.0743
Mean	0.1874	0.2843	0.2819	0.0982	0.3556	**0.0175**	0.254	0.0665

Meanwhile, the same pattern also obtained for correlation between the area of in *Ubiquitous computing* and programming skills, as shown in Table IX. That is, the result also showed a positive correlation (+) between them. However, the only *mobile game* has a significant correlation with the programming skill as the mean of the *p*-value is less than 0.05, with the value of 0.0175.

In general, the statistical result reveals the four vital significant correlations between the area of interest and programming skills for the final year project. That are the correlations of (i) *multimedia courseware* and programming skills; (ii) *user interface design* and programming skills; (iii) *web information system* and programming skills; and (iv) *mobile games* and programming skills. From these correlations, we may conclude that these students programming skills matched the most with the area of *multimedia courseware, user interface design, web information system* and *mobile games*. Consequently, these findings may help the student to find areas of research for conducting the FYP.

Clearly, these results may not be generalised as we use mainly student from Bachelor of Information Technology (CS240) at UiTM Perlis Branch. Also, there still other programming skills may be incorporated into this study. In this context, based on the initial results, it is clear that further work is required to establish insight into the current issue with the larger sample and other programming skills.

5. CONCLUSION

In conclusion, we have proposed a pathway to assess the significant correlation between students' programming skills and the area of interest for their final year project, with the aided of a user study. Based on the current evidence, the result reveals that only the area of interest of *multimedia courseware*, *user interface design*, *web information system* and the *mobile game* has a significant correlation with the student programming skills in particular for conducting the final year student of Bachelor Information Technology (CS240) in UiTM Perlis, Malaysia.

For future work, we will develop a recommendation system to assist the student in finding the right area of study with the skill that they have. Also, we will incorporate this useful information in helping the student to find a suitable supervisor for their final year project.

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REFERENCES

[1] P. Siklander, M. Kangas, S. Ruhalahti, and S. Korva, "Exploring triggers for arousing interest in the online learning," in *International Technology, Education and Development Conference*, 2017, pp. 9081–9089, Accessed: Apr. 02, 2020. [Online].

[2] J. Jawitz, S. Shay, R. M.-I. J. of Engineering, and U. 2002, "Management and assessment of final year projects in engineering," *International Journal of Engineering Education*, vol. 18, no. 4, pp. 472--478, 2002, Accessed: Apr. 02, 2020. [Online].

[3] D. Srinivasan and L. Rachmawati, "Efficient fuzzy evolutionary algorithm-based approach for solving the student project allocation problem," *IEEE Transactions on Education*, vol. 51, no. 4, pp. 439–447, 2008, doi: 10.1109/TE.2007.912537.

[4] M. H. Ismail, T. R. Razak, M. A. Hashim, and A. F. Ibrahim, "A Simple Recommender Engine for Matching Final-Year Project Student with Supervisor," in *Colloquium in Computer and Mathematical Sciences Education (CCMSE 2015)*, Aug. 2015, Accessed: Sep. 13, 2019. [Online].

[5] J. Mateo, A. Escofet, F. Martínez-Olmo, J. Ventura, and D. Vlachopoulos, "Evaluation Tools in the European Higher Education Area (EHEA): an assessment for evaluating the competences of the Final Year Project in the social sciences," *European Journal of Education*, vol. 47, no. 3, pp. 435–447, Sep. 2012, doi: 10.1111/j.1465-3435.2012.01536.x.

[6] H. Ku and S. Goh, "Final year engineering projects in Australia and Europe," *European Journal of Engineering Education*, vol. 35, no. 2, pp. 161–173, May 2010, doi: 10.1080/03043790903497336.

[7] M. B. Gusau, M. M. Mohamad, Y. Yusof, and A. Ahmad, "Investigating Students` Cognitive Style and Problem Solving Skills in Conducting Undergraduate Final Year Project | Online Journal for TVET Practioners," *Online Journal for TVET Practioners*, vol. 4, no. 1, 2019, Accessed: Apr. 02, 2020. [Online].

[8] K.-E. Ting and S.-M. Cheah, "Assessment of CDIO Skills for Student Final Year (Capstone) Projects of Different Genres," in *6th International CDIO Conference*, 2010, pp. 15--18, Accessed: Apr. 02, 2020. [Online].

[9] T. Ball and B. Zorn, "Teach foundational language principles," *Communications of the ACM*, vol. 58, no. 5, pp. 30–31, May 2015, doi: 10.1145/2663342.

[10] D. Topalli and N. E. Cagiltay, "Improving programming skills in engineering education through problem-based game projects with Scratch," *Computers and Education*, vol. 120, pp. 64–74, May 2018, doi: 10.1016/j.compedu.2018.01.011.

[11] M. Healey, L. Lannin, A. Stibbe, and J. Derounian, *Developing and enhancing undergraduate final-year projects and dissertations*. Higher Education Academy York, 2013.

[12] K. J. Ostergaard, W. Wetmore, and J. D. Summers, "A Methodology for the Study of the Effects of Communication Method on Design Review Effectiveness," in *Volume 2: 29th Design Automation Conference, Parts A and B*, Jan. 2003, pp. 383–390, doi: 10.1115/DETC2003/DAC-48742.

[13] D. Tesch, M. G. Sobol, G. Klein, and J. J. Jiang, "User and developer common knowledge: Effect on the success of information system development projects," *International Journal of Project Management*, vol. 27, no. 7, pp. 657–664, Oct. 2009, doi: 10.1016/j.ijproman.2009.01.002.

[14] T. R. Razak, J. M. Garibaldi, C. Wagner, A. Pourabdollah, and D. Soria, "Interpretability and Complexity of Design in the Creation of Fuzzy Logic Systems — A User Study," in *2018 IEEE Symposium Series on Computational Intelligence (SSCI)*, 2018, pp. 420–426.

[15] T. R. Razak, J. M. Garibaldi, C. Wagner, A. Pourabdollah, and D. Soria, "Towards a Framework for Capturing Interpretability of Hierarchical Fuzzy Systems - A Participatory Design Approach," *IEEE Transactions on Fuzzy Systems*, pp. 1–1, 2020, doi: 10.1109/TFUZZ.2020.2969901.

[16] P. Ahlgren, B. Jarneving, and R. Rousseau, "Requirements for a cocitation similarity measure, with special reference to Pearson's correlation coefficient," *Journal of the American Society for Information Science and Technology*, vol. 54, no. 6, pp. 550–560, Apr. 2003, doi: 10.1002/asi.10242.

[17] S. Siegel, *Nonparametric Statistics for the Behavioral Sciences*. 1956.

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