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Evaluating Students' Perception of Teaching/Learning Computer Programming: A Study in a Bruneian Technological University

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Abstract: The present study is part of one of the pioneering government funded research, conducted in one of the institutions of higher learning in Brunei Darussalam. The study validates the existing instrument through survey (factor analysis) among cohort of students in a programming class. The study results not only endorse the reasons of declining the art and science of teaching/learning computer programming but also have brought an interesting finding of pedagogy. The results indicate that teaching and learning strategies are more teacher-centered (mean=3.85) rather than student-centered (mean = 2.87). This is in contrast to modern approach of teaching-learning, where problem-based or constructivist approach dominates. Further 67% of the students considered lack of motivation, 80% considered the curriculum is less practical and 50% thought it was more teacher-centered, as key reasons of this decline. Based on the findings some recommendations were made to the relevant authorities to improve the practice.

Keywords: *Teaching/learning pedagogies, computer programming, technical institutions, higher learning, Brunei Darussalam*

1. Introduction

In today's competitive world, academic institutions of higher learning are striving hard to deliver the excellence in teaching and learning; not only meeting the quality but also to gain a competitive advantage. In this regards, the institutions of higher learning are facing a surmountable task of devising the right pedagogies that can foster the institution's image and improve their ranking. The task has become more challenging for the technical institutions especially in delivering the technical knowledge such as in the field of computing and information technology, where the task to impart knowledge but also develop the required marketable skill. One of the challenges in this area is to cope with the declining performance and skill of the computing students in the fundamental area of computer programming. The overall results in the subject of computer programming have endorsed this as a sensitive matter. Researchers have further made this an interesting topic to research with several reasons including the selection of right pedagogy. This is also portrayed in technical institutions of higher learning in Brunei Darussalam. There is no doubt in saying that learning computer programming as a subject is a matter of not only conceptual understanding but also requires necessary skill to master the art and science of computer programming. Computer science students are expected to be well familiar on programming skills. In fact, most science, mathematics, engineering and technology programs in higher academic institutions require students to acquire programming skills as a part of their curriculum (McCracken et al., 2001; Norwawi et al., 2009).

However, the teaching and learning pedagogy in the technical institutions is based on traditional method of teacher-centered approach. Whereas, the success of this method is dependent mainly upon the teachers' attitudes as how positive attitude he or she has towards teaching the subject of computer programming. The traditional teacher-centered approach still prevail in the majority of the secondary, post secondary and vocational institutions that prohibits students to think critically beyond the text book (Hamid, 2014). During the past two decades the development in the educational sector urged for research into teacher's teaching style, students' learning abilities, students' learning style, cognitive level and learning paradigm underpinning them (Byrne & Lyons, 2001; Goold and Rimmer, 2005; Gomes and Mendes, 2008). The evidence suggested that research on the role of a teacher and students' learning using different methodologies were already well established in some areas such as teaching science and mathematics (Finson et al., 2006). Chetty and Jones (2014) studied the teaching and learning of computer programming at universities within South Africa and

found that they often make use of the traditional teacher-centric pedagogies. These pedagogies focus on teacher-centric activities such as lecturing, questioning and demonstration. The major disadvantage is that students are passive learning and they had very little time to interact with peers, tutors or lecturers and at the end emphasis was on knowledge itself rather than developing students' learning skill on writing the programs. They suggested adopting an alternative pedagogy called social constructivism to assist students in cultivating the skills needed for computer programming. Literature has provided several study examples of teaching and learning computer programming i.e. to develop skills such as discipline, critical thinking and problem solving (Preston, 2006; Sprankle, 2009).

However, as stated that in practice there exist a greater discrepancy and gap as what is being researched and what is being practiced especially in the area of teaching/learning computer programming especially in the Vocational and Technical Institutions (VTIs) so there need to be conducted more studies to examine the influence of varies teaching/learning approaches on students' cognition and perceptions among VTEs. Motivated by these concerns this study was conducted in one of the technical institutions of higher learning in Brunei Darussalam in 2014 with the following objectives:

- To examine the current pedagogies of teaching learning computer programming in technical institution.
- To suggest pedagogy to improve teaching learning computer programming in technical institution.

2. Literature Review

Conti, (2004) defined the term teaching style refers to the distinct qualities displayed by a teacher that are consistent from situation to situation regardless of the material being taught. Whereas, according to Kember's (1997*)* definition and description, there are two kinds of broad orientations in teaching: the teacher-centered conception and the student-centered conception.

***Teacher-Centered Approach*:** Teacher-centered pedagogy is an education style that focuses on how the teacher delivers information rather than how the students absorb it. It tends to involve more passive learning by the students; such as: lecturing in which the teacher disseminates the information and it is up to the student to absorb and process it (Henriksen, 2010). An activity that best describes teacher-centered pedagogy is lecturing, where teacher directs the classroom that doesn't meet diverse needs of students. However, teaching styles conflict with student's learning style. Brown, (2003) stressed that "the premise "one size fits all", which is attributed to a teacher-centered instructional approach, is not working for a growing number of diverse student populations. Teacher-centered instruction is supported by a strong set of empirical results conducted over several decades. And yet, these approaches are ignored by the leaders of the profession, as evidenced by the content in textbooks used to train teachers and in authoritative reviews of research. To discuss teacher-centered instruction is not even considered polite conversation. Nevertheless, now is the time for social studies leaders as well as legislators and parents to acknowledge the obvious weaknesses of student-centered approaches and begin to correct the excesses. We should acknowledge that poor teaching and learning do indeed create discomfort among students. Results from the National Assessment of Educational Progress have shown repeatedly that U.S. students have scant understanding of mathematics and programming. It is likely that this dismal state of affairs is the result of a century of ignoring content and promoting instructional practices with little chance of classroom success. The failure to improve academic achievement should be placed at the doorstep of the progressive reforms and perhaps an emphasis on results-oriented reforms can create a new energy in teaching-learning computer programming and to help us focus our attention on academic achievement rather than prolonging the endless debate between the advocates of teacher-centered and student-centered approaches in computer programming.

***Student-Centered Approach*:** In the literature, there are two approaches to learning: a surface approach of learning and a deep approach (Entwistle and Ramsden, 1983; Biggs, 1987). The surface approach to learning involves attempting to memorize the information that is considered to be important. The deep approach, on the other hand, involves developing an understanding of the content. Gibbs and Coffey (2004) explain that "students who take a deep approach have been shown, in a wide range of studies, to have superior learning outcomes, particularly in terms of understanding and developing new and more sophisticated conceptions of

the subject". Besides these two separate continuums, there are alternative approaches to teaching. Postareff et al. (2008) provide an overview of the literature on approaches to teaching. To them, academic teachers have different conceptions of teaching. Some teachers conceive of teaching as the transmission of knowledge from themselves or the textbook to the learners. Other teachers focus on the learners, viewing their own role as a facilitator of learning. The conception of teaching which teachers adopt has been shown to relate to the teaching approaches that they adopt: a teacher-centered approach or student-centered approach (Prosser et al., 1994). They said that teachers with an information-transmission conception of teaching often take a teacher-centered approach to teaching. This approach views students as passive recipients of the teacher's already-constructed knowledge. Teachers who view themselves as facilitators of learning will often take a student-centered approach to learning, helping students as they construct their own knowledge and understanding. We need to add that these two approaches are not necessarily independent of each other for example, teachers taking a student-centered approach might at times attempt to transmit knowledge as part of their overall instructional method. However, Trigwell et al. (1999) found that "an information transmission/teacher-focused approach to teaching is strongly associated with surface and non-deep approaches to learning and that a student-focused approach is associated less strongly, with a non-surface approach to learning. It is interesting to state that several other researchers like; Spoon and Schell, (1998); Conti, (2004) and Liu et al. (2006) in their USA based studies found that most instructors still use traditional teacher-centered styles in university setting despite the call for a paradigm shift to learner-centered ones.

Student-Centered Approach in Teaching-Learning Computer Programming: There is no doubt about the notion that teaching-learning computer programming is a fundamental part of computer science curriculum and is stated as a problematic in the studies (McCracken et al., 2001; Milne and Rowe, 2002). The literature has reported this as a universal problem (ibid) that have motivated many researchers to propose various methodologies, tools and pedagogies to help students. Among these tools some reported to have positive effect on teaching-learning, however, in most of the cases the problem remains unsolved (Ala-Mukta, 2004). Some studies reported several reasons that caused this learning problem (Gomes and Mendes, 2008). One of them is the students' disability in problem-solving approach coupled with lack of critical thinking. Many students don't know how to program because they fail to demonstrate their ability to create algorithms. Gomes and Mendes, (2008) identified the problem within teaching methodology with the following pedagogical weaknesses: 1) Teaching is not personalized, 2) Teaching strategies don't support all students' learning style, 3) The teaching of dynamic concepts through static material, 4) Teachers are more centered on teaching a programming language and its syntactic details instead of practicing problem solving techniques using a programming language. In short teaching programming is more teacher-oriented.

Ala-Mukta, (2004) along with several other studies (Kay et al., 2000; Robins et al., 2003) has identified problems in Learning and Teaching Programming. Winslow (1996) noticed that students may know the syntax and semantics of individual statements, but they do not know how to combine these features into valid programs. Deek et al. (1998) developed a problem-solving approach for a programming course that focuses on more experiential learning techniques. Rahmat et al. (2012) conducted a study at Malaysian Institute of Information Technology and found the major barriers and problems faced by the students in learning programming. To them lack of student-centered pedagogy, majority of the students memorize the processes without understanding them that leads the students to get low grade in their programming subjects. In another study in Malaysia, Higher Learning Institute, Suliman et al. (2011) noticed a higher rate of under achievers and suggested the right pedagogical approach of teaching-learning programming in schools would reduced the problem. Xiaohui, (2006) conducted a study in China and discussed the current conditions and characteristics of computer programming in Ocean University of China was discussed then he discussed the advantages and disadvantages of traditional teacher-centered learning strategies were discussed and finally the teacher-centered approach was modified with student-centered approach of teaching-learning such as concept mapping, peer learning and e-learning was discussed. The result showed a big difference in student achievement in results with new pedagogy. Govender and Grayson, (2006) studied learning to program and learning to teach programming in one of the South African universities and found a link between mathematics and computer programming, the students' problem solving ability and facilitation of problem solving in classroom teaching. Similarly Hawi, (2010) conducted a study in Lebanon and found that with the implementation of student-centered approaches the students migrated from the state of passive receivers to

constructors of computer programming concepts. Students learned exploration, individuality and autonomous thinking that promoted the learner-centered approach.

In Brunei there is limited number of studies are available. In recent past, two studies were undertaken to find out the reasons of students' decline in programming in technical institution of higher learning. Seyal et al. (2015) found the not understanding the students' learning style will affect their performance in subject of computer programming. Similarly, in another study Looi and Seyal (2014) discussed the role of problem-based learning in analyzing the students' performance in subject of computer programming. They found that problem-solving and soft skills gained through PBL enhanced students' employability after they graduate. In summary it is evident that revising pedagogy from teacher-centered environment to learner or student-centered environment has more potential and if implemented carefully could further improve the students' learning of computer programming.

3. Methodology

Design of instrument: From the review of the literature and on the basis of the study design, the questionnaire was adapted after Gilis et al. (2008). The multidimensional instrument was developed in two parts to capture the information. Part 1 contained demographic and information about students learning skills and result in the programming assignment consisting of questions with nominal and ordinal measurements. Part 2 captured the information on ten about two different types of methodologies multi-dimensional constructs using 5-point Likert scale (1-strongly disagree to 5 for strongly agree). Table 1 provides details of the sources of constructs and the number of items used in this study.

Sampling & Data collection: Inorder to achieve this convenience sampling method techniques was conducted with the selection of two government offices close to the authors' workplace. The questionnaire was distributed to fortystudents that were currently retained as control group.The study was conducted in Aug-Sept 2014.The basic statistics and reliability coefficient are provided in the Table 1.

Limitation of the Study: The study is not free from its weaknesses. The small sample size used for this pilot study is subject of standard error. Secondly, all data measuring the students' learning pedagogy for programming class came from self-report so it is possible that common method variance influence the results and those data collected on different time or through different methodologies could produce different results. So, any attempt to generalize the results based upon small sample size of this study is used with caution and advisable to be used with other methodologies. Finally, the study does not include any demographics such as gender, age and prior experience in making comparison of both teacher-centered and student-centered approaches. Future study with the inclusion of these variables might identify the difference.

Validity and Reliability: In order to assess the validity and reliability, tests were performed in this study. To get the reliability of the questionnaire, the coefficient of Cronbach's alpha (1951) was taken into account. Minimum Cronbach's alpha value of above 0.70 indicates reliability of the instrument (Nunnally, 1978). During the initial screening of conducting reliability tests, the items were dropped because of low corrected-item total correlation which was less than .40, the cut-off value suggested (Hair et al., 1998). The remaining items were applied where the factor analysis was subjected to principal component analysis using varimax rotation. In addition, we applied the criteria of Kaiser-Normalization as techniques of rotation to examine both the individual items and the relationship among them (Hair et al., 1998). All the items that were loaded on more than one factor at cut-off value of .40 were eliminated from the constructs. In addition, two types of validity were assessed to validate: convergent and discriminant validities. Churchill, (1979) has suggested that convergent and discriminant validities should be examined for construct validity. Therefore, we assessed convergent validity by examining composite reliability (CR) and average variance extracted (AVE) from the two constructs (Hair et al., 1998). CR is calculated by squaring the sum of loadings, and then dividing it by the sum of squared loadings, plus the sum of the measurement error whereas, the AVE is measured with the variance captured by the indicators relative to measurement error. Table 1 provides the quality control; statistics with internal consistency and CR values. The CR values of both the constructs were between the suggested minimum of 0.70 (Hair et al., 1998). Table 1 also represents the variance. The average variance extracted above 0.50 suggests a further evidence of convergent validity (Fornell and Larcker, 1981) These

AVE values could also be used to assess discriminant validity which occurs when the AVE exceed the square pair wise correlation between the construct (Espinoza, 1999). Table 3also shows the inter-constructs correlation.

Table 1: Quality Control Statistics

Constructs	No of original items	No of items retained	Alpha value (.60 and above)	Mean	Variance explained <.50	CR	Source
Student-centered	6	4	.77	2.87	.55	.72	Gilis et al. (2008)
Teacher-centered	4	3	.70	3.85	.60	.75	Gibbs & Coffey, (2004)
Total	10	7					

4. Data Analysis and Results

Data obtained from the survey were analyzed using descriptive statistics, factor analysis as well as correlation and regression analysis by using SPSS version 20, a well-known statistical package.

Background profile: The background data of users as well as their organizational profile is summarized in Table 2. The Table describes the characteristics of respondents. Majority of the users is relatively young female (57%) within age group of 21-23years (47%). Majority of the learners (82%) are beginner level. It is strange to notice that 60% of the learners have average programming knowledge. Lack of motivation and low practical values are most cited reasons for lower programming learning.

Table 2: Demographical data

Variable	Description	Percentage
Gender	Male	43%
	Female	57%
Age	Between 18-20	20%
	Between 21-23	47%
	Between 24-26	30%
	Above 26	3%
Level of Programming	Beginners	82%
	Advanced level	14%
Level of Programming knowledge & skill	Very little	10%
	Average	60%
	Above average	30%
Performance	Marginal pass	27%
	Credit	30%
	Merit	34%
	Distinction	9%
Reason of low performance*	Lack of motivation	67%
	Less practical value	80%
	Teacher-centered	45%

**Multiple responses*

Correlation Analysis: Prior to the testing for the exploratory factor analysis, we conducted a zero order correlation between the various independent variables as shown in Table 3. The correlation provides directional support for the predicted relationship and shows that co-linearity among the independent variables are within the acceptable range (Hair et al., 1998). Result shows a significant correlation between teacher-centered approach and students' result.

Table 3: Correlation Matrix

Constructs	TC	SC	RES
Teacher-Centered (TC)	**1.00**		
Student-Centered (SC)	.103	**1.00**	
Student Result (RES)	.211*	.019	**1.00**

* P<0.05

Exploratory Factor Analysis: The ten instructional behavior variables were further analyzed to the exploratory factor analysis techniques (EPA), where principle component factor analysis method was used to determine and confirm the underlying pattern. Varimax rotation procedure was employed for obtaining any simplified structure pattern. The rotated matrix has produced two factor solutions. Factor 1 is named as Student-centered teaching; and Factor 2 as Teacher-oriented teaching. Three items were dropped that have the corrected-item correlation less than recommended value of .40 prior to running the factor analysis. All retained seven items have factor loading that are above the cut-off value of 0.60 thus full-filling the criteria of Hair et al. (1998). In addition, examination of the initial statistics reveals that two factors account for 71.60% of the variance. Finally the Bartlett test of sphericity is significant and the Kaiser-Meyer-Olkin measure of sampling adequacy is greater than .6. Therefore, it is appropriate to proceed with factor analysis.

Table 4: Exploratory Factor Analysis

Item No	Items	Factor1 Student-centered	Factor 2 Teacher-oriented
3	We choose the topics we want to study in programming	.87	
4	The lecturer uses our ideas and suggestions when planning programming lecture	.77	
9	We have do practical's-programming exercises ourselves as a part of programming learning	.77	
10	The class breaks into small groups to do programming exercises, assignments and practical during programming learning	.78	
5	We watch the lecturer doing the programming examples during our programming lecturer/tutorial		.71
6	The lecturer makes programming lectures interesting for us.		.77
7	We copy the lecturer's notes from power point /white board during our programming lecture/tutorial		.86
	% of Variance	56.1%	14.5%
	Cumulative Variance (%)	56.1%	**71.60%**

Kaiser-Meyer-Olkin measures of sampling adequacy = .82
Bartlett's test of sphericity: App Chi-square = 44.47, df =21, P =.002

Discussions: The study has fulfilled the objectives. The teaching-learning of computer programming was analyzed through factor analysis (Table 4) and has confirmed the two factors solution: teacher-centered and student-centered. However, the higher mean as shown in Table 1 that predominant style of teaching learning the computer programming to the student in technical institution of higher learning is teacher-centered. The findings concur with many previous studies that reported instructors are following the traditional approach of teaching computer programming. The results further support the findings of Spoon and Schell, (1998) and Liu et al. (2004) who reported a moderate preference for a teacher-centered approach by both teachers and learners. Conti, (2004) concludes and confirms that teacher-centered style remained dominant at all level of education in North America till 2004. The study also supports the previous work of Henriksen, (2010) and Brown, (2003). The study provides further support to the identification of teacher-centered style in practice in university setting especially teaching-learning the computer programming. In another research Seyal et al. (2015) have confirmed that pedagogy based on teacher-centered significantly contribute towards low performance of the students in their computer programming class.

In compliance with our second objective as to suggest pedagogy to improve teaching-learning computer programming, we agree with various research theories that have always advocated strategies, methods and

activities that are associated with learner-centered teaching style. The learner-centered style is regarded as an effective and democratic way of improving students' motivation, participation and final achievement in teaching-learning computer programming. Our results further identify the gap in theory and practice as it further indicates that in one hand the traditional teacher-learner paradigm are being questioned as one of the barriers towards university mission of delivering the best pedagogy for competitive advantage, on the other hand, more detailed analysis should be conducted at Board's level to specify what are genuine learner-centered action and what are teacher-centered approach (Liu et al., 2006). The results are in contrast with Looi and Seyal (2014) who have selected a cohort of students that were identified as weakest students in a class of computer programming in a single institution of higher learning. Their probability of passing based on their test results were at the minimum level. They were given problem-based learning (PBL) approach. The result showed the significant improvement in the students' result and performance.

5. Conclusion

The study results confirm that in technical institution the teacher-centered are dominant teaching-learning style to teach computer programming. This is contrary to the research in learner-centered approach that is praised in the research and practice to address individual learner's needs and to capitalize on students' performance in providing a better teaching-learning platform. The study also concluded in the discrepancy between theory and practice emphasizing that student-centered approach is not widely practiced especially teaching computer programming. The study thus provides an insight and awareness of this discrepancy by encouraging university's administration to address this issue accordingly and to look into the matter prudently in enhancing the teaching-learning as how more training workshop can promote learner-centered approach.

Recommendation for the Practice: It is obvious from the review of literature that studies have fostered the dynamic believe that a student-centered classroom provides a more efficient learning environment and most of the institutions are capitalizing to support this at their end. The same is true for the technical institution of higher learning (IHL) in Brunei Darussalam. A positive response to student concerns can result in student-centered environment. There are several approaches are available such as constructivism as a paradigm for teaching and learning, problem-based learning, collaborative learning and critical thinking approach, however, the successful implications require careful planning and meeting the various challenges. Employing student-centered approaches has no end. It makes the course subject to revision and reframing. Problem-solving sessions helped the students to construct their own meaning in a discovery-learning setting. All these methodologies bring a daunting challenge of change at every level not only at course design, the classroom management, technology support, assessment procedures, and team building but also in shifting the mind-set as well. Secondly, in order for student-centered learning to be implemented the policy makers and designers must be aware of the key issues and belief of the teachers about these issues such as: 1) why would the instructors/teachers need to adopt a learner-centered approach? 2) How could this approach be adopted. 3) Can learner-centered approach be used within large classrooms? 4) Can learner-centered approach be implemented in various stages? and 5) how to respond to students' resistance while introducing learner-centered environment. Considering issues similar to these will resolve many ambiguities and would enhance the process of student-centered teaching-learning computer programming at IHL[1].We also suggest learning from best practices such as in Malaysia many universities began to implement PBL in their curricula in an effort to improve the quality of education. With collaboration with Aalborg University of Denmark, PBL was introduced at University Tun Hussein Onn Malaysia (UTHM) (Berhannudin et al., 2007). Similarly, Monash University in Australia was the second university to adopt PBL within its medical school environments (www.med.monash.edu.au/srh/medical-education/.../issue10red.pdf).

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[1]*Readers are encouraged to refer: Froyd, J., and Simpson, N. 2008. Student-centered learning addressing faculty questions about student-centered learning* (www.ccliconference.org/files/2010/03/froyd-stu-centeredlearning.pdf) *for more reading*.

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