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Local population: A study in the Influence of Learning Styles in Computing Field

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ABSTRACT

Background: Learners have preferences about how they like to learn. Existing literature suggests that understanding learning style of local population is helpful providing them an effective learning experience. **Objective:** The main objective for this paper is to determine the learning styles preferences of computing learners. **Results:** Local learners are more towards visual learning style, with the most significant difference from international learners. Local learners prefer reflective, while international learners prefer active. Both the local and international learners opt for sensing and sequential learning styles. **Conclusion:** A range of teaching ways and learning exercises should be provided in computing education in order to match the local variety of learning styles.

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INTRODUCTION

Learning style refers to the description of different and preferred methods that people learn. In local population, the broad coverage of computing topics and the constraints of time in physical classes could reduce the effectiveness of teaching-learning interactions. Knowledge and preference of learner's learning style is important to teaching and learning process. This knowledge can help to develop, design and deliver educational courses to enhance learning for local population. Romanelli *et al.* (2009) supports that a match between the learning style and the teaching style will lead to improved student attitudes and better academic achievement.

Felder-Silverman (1988) define learning styles of learners in a detailed manner with four dimensional preferences, most of the learning style models classify learners a few groups. We use Felder-Silverman style in this study to integrate learning style into computing education. We select Felder-Silverman Learning Styles Questionnaire (LSQ) due to a number of reasons. Firstly, it has been widely used in previous studies involving university students (Goulding and Syed-Khuzzan, 2014; Demirkan and Demirbaş, 2008; Manochehr, 2006). Secondly, compared to other tools such as Vermunt's learning style (1998), and Myers-Briggs'

Type Indicator (Myers *et al.*, 1998), LSQ has easier and accessible items online, thus, it can be completed in a shorter time.

Felder-Silverman Learning Style Model:

Felder-Silverman Model classifies learners as having preferences in one category or the other in each of the following four dimensions. Each of them includes two poles (Graf *et al.*, 2007; Felder and Spurlin, 2005):

1. Active and reflective learners:

- Active (Act.) learners learn by trying things out and working with others. Furthermore, they tend to be more interested in communicating with others and prefer to learn by working in groups where they can discuss about the learned material.
- In contrast, reflective (Ref.) learners in a class allow little or no class time for thinking about new information. They try to compensate for this lack when they study. They do not simply read or memorize the material; stop periodically to review what they have read and think of possible questions or applications. They can find it helpful to write short summaries of readings or class notes in their own words. Doing so may take extra time but will enable them to retain the material more effectively.

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2. Sensing and intuitive learners:

- Sensing (Sen.) learners like to learn concrete material and tend to be practical. They tend to like learning facts. They like to solve problems with standard approaches and tend to be more patient with details. Sensors tend to be more practical and careful than intuitors.
- Intuitive (Int.) learners prefer discovering possibilities and relationships. Intuitors like innovation and dislike repetition. They may be better at grasping new concepts and are often more comfortable than sensors with abstractions such as theories and their meanings. Intuitors tend to work faster and to be more innovative than sensors.

3. Visual and verbal learners:

- Visual (Vis.) learners remember best what they have seen and therefore prefer to learn what they have seen (e.g. pictures, diagrams and flow-charts). They get more out of graphical representations. Most people are visual learners, where most learners may get nearly as much as they could if more visual presentation were used in class.
- Verbal (Ver.) learners get more out of words – written and spoken explanations. Verbal learner can find it helpful to write summaries or outlines of course material in their own words. Working in groups can be particularly effective, which they can gain understanding of material by hearing classmates' explanations and can learn even more when they do the explaining.

4. Sequential and global learners:

- Sequential (Seq.) learners learn in linear steps and prefer to follow linear stepwise paths in finding solutions and are more interested in details. Sequential learners may not fully understand the material but they can nevertheless do something with it (like solve the homework problems or pass the test) since the pieces they have absorbed are logically connected. They may know a lot about specific aspects of a course but may have trouble relating them to different aspects of the same course or to different courses.
- In contrast, Global (Glo.) learners use a holistic thinking process and learn in large leaps. They tend to absorb learning material almost randomly without seeing connections but after they have learned enough material, they suddenly get the whole picture. They tend to find connections between different areas and the whole picture is important for global learners.

In most of the previous research studies carried out before, learning styles of students in western universities have been studied. These students or learners have a different cultural background from

local Malaysian university students. Therefore, they cannot be generalized with western findings. Studies mentioned above point out that according to learning styles of learners, their preference of learning activities change. In this framework, it is necessary to detect the learning style of local population and what kind of learning activities they prefer must be investigated.

Research objective:

The aim of the study is to adapt Felder-Silverman learning styles instrument to the local population of computing students. Three research questions lead this study:

1. What are the preferred learning styles of the sample of the study according to Felder-Silverman as a learning styles instrument? This helps to generalize to the local and international population.
2. Is there a meaningful difference of learning styles between local and international population for computing students?
3. How much average time taken for a participant to complete Felder-Silverman learning styles instrument?

Method (Procedure):

Participants consisted of 291 Multimedia University (MMU) students, 208 males and 83 females. The ages of the sample ranged from 18 to 26, and the age of 27 and above are nine students. The average age is 21.94, with standard deviation of 2.358. The students who participated in this study underwent Software Engineering Fundamentals, and Software Requirements Engineering courses (over the year 2009, 2010, and 2014) in Faculty of Computing and Informatics by using "convenient sampling" method. The distribution of the sample was as follows: Local (n=183, 63%), and International (n=108, 37%).

The Index of Learning Styles Questionnaire (LSQ) was used in this study. LSQ was originated from Felder-Silverman (1988), which focused on the structure of learning styles of engineering students. The online learning styles instrument was added in 1997 (Felder and Solomon, 2001) to evaluate the preferences of students in four dimensions and 44 items with option (*a* or *b*). The four dimensions are Active-Reflective, Sensing-Intuitive, Visual-Verbal, and Sequential-Global learning styles. The result score indicates the learning style that the individual acquires. Figure 1 shows the LSQ feedback form, which the participants circle according to the result as displayed in their computer screens.

Complete the questionnaire found on the website by following the web address given below. Enter the address and record your start time before commencing the questionnaire: (Please record time as 'hh:mm:ss')

▲ Record Start Time: _____

<http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

Please circle the result as displayed in the screen:

ACT REF
11 9 7 5 3 1 1 3 5 7 9 11
<-- -->

SEN INT
11 9 7 5 3 1 1 3 5 7 9 11
<-- -->

VIS VRB
11 9 7 5 3 1 1 3 5 7 9 11
<-- -->

SEQ GLO
11 9 7 5 3 1 1 3 5 7 9 11
<-- -->

▲ Congratulations! End Time: _____

Fig. 1: Learning styles response sheet

The Index of Learning Styles (ILS) is available at no cost to help instructors or students who intend to use it for classroom instruction or research (ILSweb, 2015). Each learning style dimension has associated with 11 double-choice items, with each option (*a* or *b*) pertaining to one or the other category of the dimension, such as active or reflective. The online version of the instrument subtracts the '*b*' responses from the '*a*' responses to obtain a score that is an odd number between -11 to +11 (Felder and Spurlin, 2005).

Statistical Analysis:

We analyzed the data using the Statistical Package for Social Science (SPSS) tool (Norusiš, 2008). Results are expressed as mean \pm SD (standard deviation). Categorical variables were analyzed using Levene's independent samples *t*-Test. A *p*-value of < 0.05 was considered statistically significant.

Results:

To answer the first research question with regards to the preferred learning styles of university students on each of learning styles dimensions, we report the means and SDs of learning styles of local and international learners in Table 1.

Table 1: The means and standard deviations of learning styles

Learning styles	Group	N	Mean	SD
Active-Reflective (Act.-Ref.)	Local	183	0.30 (Mild Ref.)	4.118
	International	108	-0.37 (Mild Act.)	4.457
Sensing-Intuitive (Sen.-Int.)	Local	183	-1.23 (Mild Sen.)	4.267
	International	108	-1.28 (Mild Sen.)	4.620
Visual-Verbal (Vis.-Vrb.)	Local	183	-5.92 (Moderate Vis.)	4.091
	International	108	-4.81 (Moderate Vis.)	3.529
Sequential-Global (Seq.-Glo.)	Local	183	-0.91 (Mild Seq.)	3.744
	International	108	-1.39 (Mild Seq.)	4.087

Using the visual \pm verbal dimension as an example, +8.00 to +11.00 responses would represent a strong preference for verbal learning, +4.00 to +7.99 a moderate preference for verbal, and +0.00 to +3.99 a mild preference for verbal. Next, -0.01 to -4.00 would represent a mild preference for visual learning, -4.01 to -8.00 a moderate preference for visual, -8.01 to -11.00 a strong preference for visual. This method was used in the analysis of the means.

The results in Table 1 indicate both local and

international groups prefer mild sensing, moderate visual, and mild sequential learning. Nevertheless, local group is seen with mild reflexive, while international group is in mild active learning.

In order to address the second research question that pertains to any meaningful difference of learning styles between local and international population, a series of *t*-Tests for independent samples were calculated and results are reported in Table 2.

Table 2: Differences in learning styles of sample using t-Test

Learning styles	N	Mean difference	Std. error difference	df	t	p
Active-Reflective	291	0.67	0.515	289	1.302	0.446
Sensing-Intuitive	291	0.05	0.534	289	0.090	0.454
Visual-Verbal	291	-1.10	0.472	289	-2.336	0.009*
Sequential-Global	291	0.48	0.470	289	1.013	0.640

Note: * Statistically significant at 0.01 level

Table 3: The means and standard deviations of LSQ-time

Category (Dependent variable)	Group	N	Mean	Standard Deviation (SD)
LSQ-time (mm:ss)	Local	183	09:57	04:04
	International	108	10:19	04:51

The results in Table 2 show that the t value of the mean difference of visual-verbal learning dimension was significant ($p \leq 0.01$). Thus, we found visual-verbal learning styles $t(289) = -2.336$, $p \leq 0.01$. There is a significant difference between local and international learners regarding visual-verbal learning styles. However, there is not a significant difference for other learning dimensions. In fact, results from Table 1 further shows that local visual learner had the most negative mean indicating that visual learning style was the most preferred leaning style by local computing students.

To answer the third research question, in Table 3, we calculate and report the means and standard

deviation of student LSQ completion time (LSQ-time) according to local and international groups. We see that the average time taken to complete Felder-Silverman LSQ for local group is 9:57 minutes, while international group is 10:19 minutes. We can conclude international group take longer time than local group in completing LSQ.

Table 4 shows the result of independent samples t -Test with the aim of comparing local and international learners. There is no significant difference between the two groups in LSQ-time. Anyhow, knowing the average LSQ-time can be beneficial as an estimate on how much time a participant need to complete Felder-Silverman LSQ.

Table 4: Differences in LSQ-time of sample using t -Test

Categories	N	Mean Difference	Std. error difference	df	t	P
LSQ-time (mm:ss)	291	00:31	00:21	289	-0.663	0.158

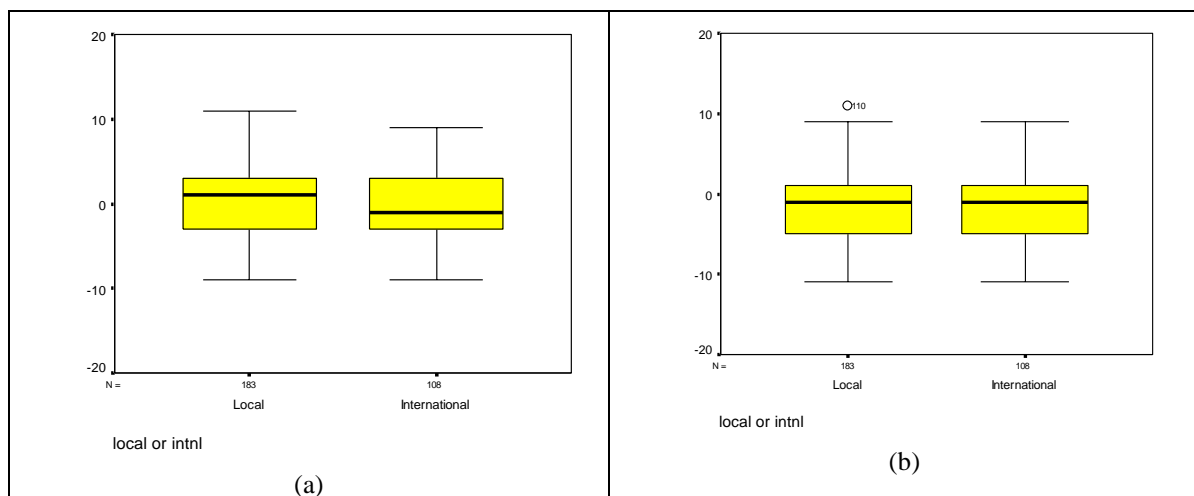
Discussion:

Previous studies that used direct supervision of questionnaire administration produced almost 100% response rate (Barron and Arcodia, 2002; Furham *et al.*, 1999; Lashley and Barron, 2006; Shaw and Marlow, 1999). We adopted similar method of questionnaire administration and achieved full response rate.

The present study completed Felder-Silverman ILS' adaptability by translating into the local population. As such, the study investigated the preferred learning styles of university computing students. We further examined the differences between local and international population of the learning styles. Zwanenberg *et al.* (2000) concluded that ILS is the best used to allow individuals to

compare the strengths of their relative learning preferences rather than offering comparisons with other individuals' basing this assertion in part on their lack of success in predicting academic performance from ILS scores.

The first research question addressed that according to the preferred learning styles dimensions of the local university students' results showed that the most significant learning style is visual learning style. Local learners prefer reflective, and international learners prefer active. Results have also shown that preferred learning styles in two remaining dimensions are: both groups prefer more in sensing and sequential. Figure 2 shows box and whisker plots to gauge medians and frequencies (Devore, 2008) of each learning style dimension.



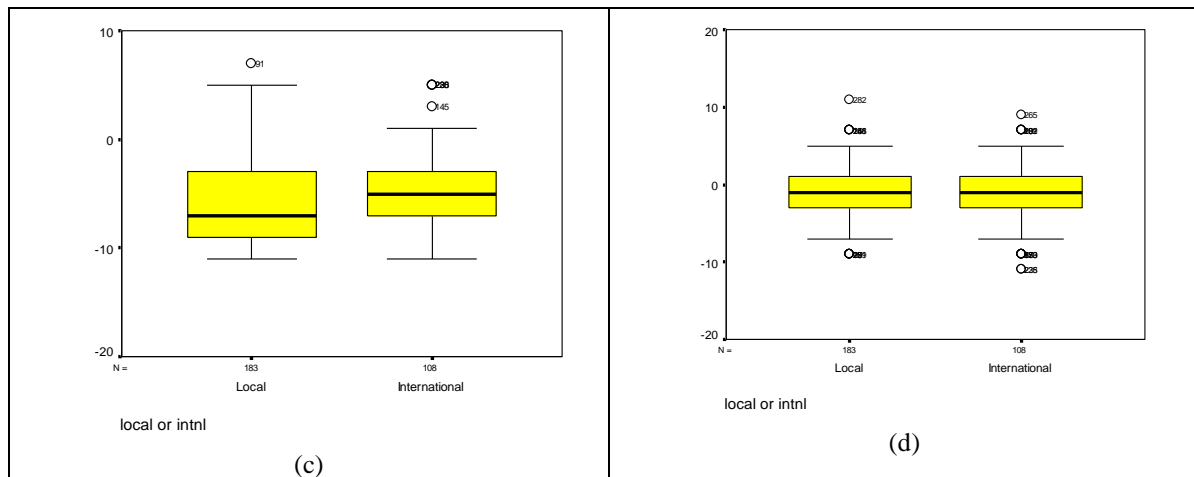


Fig. 2: Box and Whisker plots show frequencies of (a) Active-Reflective (b) Sensing-Intuitive (c) Visual-Verbal (d) Sequential-Global (see online version for colours)

Findings of the study made by Weng (2001) have revealed that most of the university students want activities in lessons, which are suitable to their learning styles, and the activities they prefer are the ones based on actual scenario. Beside this, Anthony and Yangerber-Hicks (2000) have revealed that most of university students do not learn well with learning activities which aim to think independent and abstract. So in a sense, with the support of our study, local students can be said to fit visual and reflective learning style dimensions.

In our study, educational implication would be that local computing students should be encouraged the organization of the material should be sequential (i.e. step by step, logical). The type of computing information presented should be sensing (i.e. sound, sights); which should be presented through visual modality (i.e. pictures, illustrations). It is desirable to have a balance of active and reflective. If the international learners act before reflecting, they may jump into things prematurely, while if local learners spend too much time reflecting, they may never get anything done.

With respect to second research question regarding the field of computing effect on student learning styles, the result showed that students in different population preferred different learning styles significantly in visual-verbal dimension. Consistent with this result, previous studies such as Alumran (2008), Constant (1997), Litzinger *et al.* (2005), and Zywno (2003) as in some science field studies like engineering students, visual learning style has been found more dominant than other learning styles.

Research findings to which Felder and Silverman model has been applied by Zwanenberg *et al.* (2000) have revealed that engineering and management disciplinary students are active, sensing, visual and sequential. In the findings of our study as well, both students of local and international population have been found sequential, sensing and

visual. Besides, in both the groups learning styles, significant difference has been found only in visual/verbal dimension.

Based on this result, it is interesting to note that this study found the most preferred learning style of computing students was visual learners who prefer what they see – pictures, diagrams, flow charts, and demonstrations rather than holistic approaches preferred by verbal learners. For the more inclined visual learners, as significantly detected in local population, it can be good to find visual representation of computing course material. The instructor can consult reference books, and see if any video displays of the course material are available. The local wisdom includes preparing a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections. We encourage the local learners, which are found moderate visually to colour-code their notes with a highlighter so everything relating to one topic is the same colour.

For the third research question, our findings revealed both local and international groups have a very close average time taken to complete Felder-Silverman LSQ. Based of the finding, the majority of the computing students would benefit from LSQ, especially to determine how long to conduct each LSQ session. Thus, we can allocate an estimate of 15 minutes for both local and international students to complete the LSQ. This approach would maintain the validity of university students' response so that they do not rush to hand in their feedback forms.

As an educational implication, university instructors may be able to transfer knowledge better to computing students by focusing more on visual. On the other hand, instruction that suitable predominantly to their learning styles, for instance by following stepwise paths in finding solution, sensing materials by using more audio-visual materials and encourages especially the local learners to be more active as working with others. Felder (1996) has

mentioned that the objective of university teaching should, help students develop their skills and abilities by using all the learning styles. The main goal of the proposed learning style model is to provide a good framework for designing instruction so that the learning needs of students in each dimension are met.

Conclusion:

The major aim of this study is to investigate the preferred learning styles of computing learners, and the differences in their learning styles between local and international population. One purpose of this study is to adapt Felder and Silverman model of learning styles to provide the learners an effective learning experience through statistical analyses. Findings show that preferred learning styles of local learners in the computing field are sequential, sensing and reflective learners. Results have also demonstrated that ILS has a significantly difference in visual/verbal learning style according to local and international population.

This study has unique sides which need to be noted. These are as follows: Firstly, the university students have showed preferred learning styles and it has been searched if there is a difference according to computing field. Secondly, LSQ has been used in this study and respondents are identified into one style or another. Our findings would enable the computing students to be aware of their dominant learning style preferences. The local population needs to be more balanced in their learning styles, and become more active participants in the learning process. Otherwise, their achievement in any field would be limited by their reflective behavior.

Evolutions of learning styles are required to be used with the target of classifying with purpose to anticipate about students' major programmes, career choices or to judge about their abilities of being successful with all efforts. Learning style of the student can provide a clue about a field, like the strong sides of the student, and when an additional concentration is required. Learners, who have the preference of any learning style, have the potential of being successful with all efforts. Nevertheless, students' possibilities of answering the scales willingly may decrease. Applying the LSQ before lesson or after examinations may decrease the reaction willing of students. Thus, in this study, we have collected the responses in the middle of the semester.

A range of teaching methods and learning activities should be provided in computing education in order to match the variety of learning styles. What supports the computing students, who are the respondents of this study, is that they are in visual learning style and it is in fact that they come from a learning system which passes from preliminary concepts to upper concepts and the students have affiliated between concepts and principles since primary school. The fact that the sample group in this

study is in visual learning style may have a relation with this reason. As such, it is hoped that learning styles tools, which capture the learning styles of students' unique culture, will be progressed in later studies.

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