Measuring Knowledge in Computer Network Vocational Training by Monitoring Learning Style Preferences of Students

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Abstract

Learning style preferences play a significant role during the learning and teaching process. Therefore, a multitude of researchers have developed different models to accommodate students' various learning styles. Those models share the same goal of trying to classify a particular students' learning style and to provide an overview of better teaching strategies for educators. This paper presents a research study based on a survey that investigates the learning style preferences of computer network vocational senior secondary school students in Yogyakarta Province, Indonesia. This survey uses the Index of Learning Styles (ILS) questionnaire developed by Felder and Solomon. In total, 162 data sets from five different schools in five different areas were collected in order to represent the Yogyakarta Province. The findings from the study show that students participating in computer network vocational training preferred active (82.66%), sensing (67.66%), visual (83.83%), and sequential (52.44%) learning styles. Students most strongly prefer visual and least favor verbal (16.17%). Identifying learning styles can benefit teachers as they customize teaching methods and can maximize the learning and teaching process.

Keywords: *learning style, Index of Learning Styles (ILS), Vocational Senior Secondary School, Indonesia*

1 Introduction

IIn the Yogyakarta Province, the majority of Junior Secondary School graduates choose to continue their studies at Vocational Senior Secondary Schools (VSSS) rather than to attend Senior Secondary Schools (SSS) according to data from 2012–2015 collected by Yogyakarta's Institute of Regional Planning and Development (Badan Perencanaan dan Pembangunan Daerah, or Bappeda) [1]. In addition, the number of VSSS in the Yogyakarta Province exceeds the number of SSS (211 to 155, respectively) [2]. The difference may result from an effect of the "2005–2009

Strategic Plan", implemented by the Ministry of Education and Culture [3]. One of its main tenets is to reverse the ratio of SSS to VSSS: from 70% to 30% in 2004 to 30% to 70% by 2025 [4].

Based on the data above, one can appreciate that VSSS are an important component for the development of the Yogyakarta Province. To facilitate the development of VSSS in Yogyakarta, providing a suitable method and appropriate learning resources for students is crucial. Surveying the learning styles in VSSS in the Yogyakarta Province helps to obtain accurate information about the optimal ways in which vocational school students learn.

Every student has her or his own favored learning type and unique learning style strength [5]. Some students prefer information to be presented visually, while others favor verbally presented contents. Some students would rather process ideas actively than reflectively. Certain students enjoy taking in information by sensing, whereas others prefer intuition. Numerous students like organizing material in a sequential way, yet many others require a global view. Being confronted with manifold learning styles increases the risk for educators to adopt an unsuitable strategy for the learning and teaching process. Students may reject a learning situation that does not match their learning style, potentially derailing the learning and teaching process. Many theories argue that it is essential for effective learning to design an instructional environment befitting the students' individual learning styles. Therefore, during the first step of the teaching process, the teacher must identify his/her students' learning styles. If educators prepare all materials and methods in a way designed to meet their students' needs, learning and teaching can turn into a well-planned and effective process.

2 Indonesian School System

Education in Indonesia falls under the responsibility of both the Ministry of Education and Culture (Kementerian Pendidikan dan Kebudayaan) and the Ministry of Religious Affairs (Kementerian Agama). The former manages general and vocational schools while the latter is responsible for Islamic-based schools.

As Figure 1 shows, the formal education system in Indonesia is divided into four levels: pre-school, basic education, secondary education, and higher education. Pre- school lasts for three years and is for children from four to six years old. This pre-school level is not compulsory for Indonesian children; it aims to prepare them for primary schooling. The following level is basic education, which covers nine years of education in total: six years in primary school and three years in junior secondary school. These nine years form a compulsory education program (Program

Wajib Belajar Pendidikan Dasar 9 Tahun) for Indonesian citizens. After completing basic education, pupils may attend three years of secondary education. The secondary education level comprises general SSS as well as VSSS, either in Islamic and non-Islamic institutions. The final tier in Indonesia is higher education, which is generally categorized into two types: university or polytechnic.

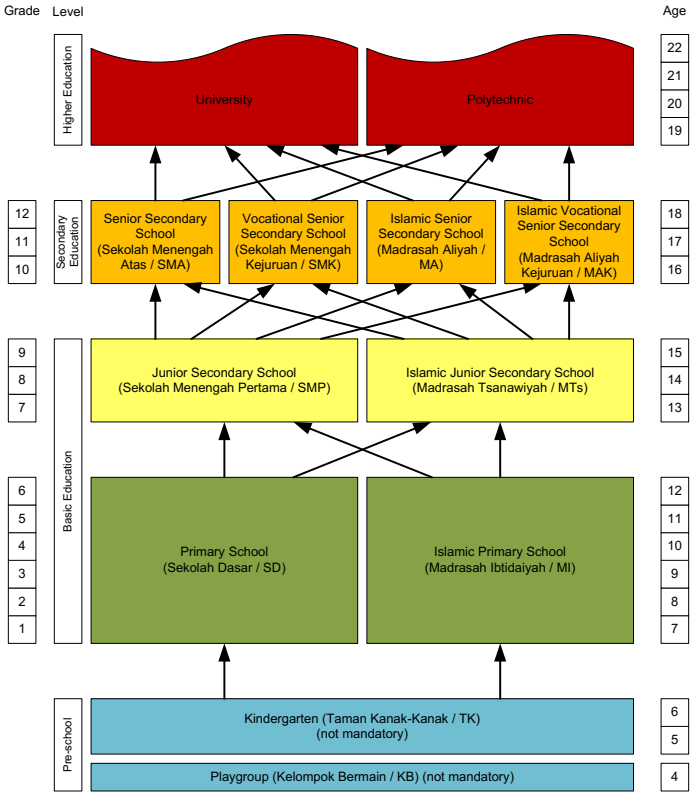

Figure 1: Indonesian School System [6-11]

Vocational secondary schools offer training in a wide range of vocational fields. Available subjects include technology and engineering, energy and mining, information and communication technology, health care and social care, agribusiness and agro-industry, maritime, business and management, tourism, and arts and creative

industry [12]. The main goal of vocational schools is to prepare students to enter the labor market immediately, especially for those who do not plan on continuing to the higher education level. In pursuit of that objective, VSSS offer a higher proportion of vocational subjects to ensure students acquire the occupational skills needed in the workplace.

3 Felder-Silverman Learning Style Model

Over the years, proponents have developed many instruments for measuring learning styles [13-19]. Different theories and parameters influence the understanding of learning styles and approaches. In the context of engineering, the most widely used is the Felder-Silverman Learning Style Model (FSLSM). Felder and Silverman, in describing how engineering students gather knowledge, classify preferences into four dimensions: active-reflective (processing information), sensing-intuitive (perceiving information), visual-verbal (presenting information), and sequential-global (understanding information) [19]. Felder and Silverman constructed this model using the example of learning and teaching in an engineering environment [20]. Zywno emphasizes that the developed instrument, which is based on the Felder-Silverman model, is a suitable psychometric tool for evaluating the learning styles of engineering students [21].

Felder and Silverman define active learners as individuals who prefer engagement through activities and discussion. Reflective learners favor thinking about information and working alone. Sensing learners desire facts and practical applications, while intuitive learners gravitate toward theory and possibilities. Visual learners prefer optical presentations (pictures, diagrams, and flowcharts), whereas verbal learners opt for both written and spoken explanations. Sequential learners study best by approaching information in linear and orderly steps. Global learners, however, prefer ideas to be organized more holistically and grasp an initial overview [22].

4 Research Method

4.1 Sample

This research focuses on vocational high school students in the Special Region of Yogyakarta, Indonesia (Daerah Istimewa Yogyakarta, or DIY). The province comprises four regencies and one city: Yogyakarta City, Bantul Regency, Gunung Kidul Regency, Kulon Progo Regency, and Sleman Regency [23]. The respondents in this study are vocational high school students from five different schools (corresponding with these five administrative subdivisions in DIY).

4.2 Preparation

Since the participants in this survey are Indonesian students, the original English ILS was translated into Indonesian. To ensure a high-quality translation, an official translator from the language center of Yogyakarta State University was commissioned. The translated contents were transposed into a final version that also took into consideration certain aspects of meaning and understanding.

4.3 Collection Procedure

A paper-based questionnaire was administered to the student-participants in 2016, at the end of one particular course meeting. A total of 162 first-year students enrolled in the Computer Network Technique program were involved in this study. The instructor contributed to the survey by distributing the questionnaires to the students roughly 20 minutes before the seminar ended. Prior to its circulation, the students were provided with a brief explanation of the survey's purpose and instructions for completing the questionnaire. Based on the research, each student took approximately 10 minutes to fill in the questionnaire.

4.4 Instrumentation

The survey instrument consists of two main parts. The first part is the set of simple questions to ascertain the demographics of participants (i.e., school of origin and sex). The second portion is the ILS created by Felder and Solomon, which is conveniently available online at http://www.engr.ncsu.edu/learningstyles/ilsweb.html [24].

The ILS consists of 44 multiple-choice questions (11 questions for each dimension) [25]. The score for each dimension is coded between +11 and -11 with a step of 2 [26]. This range results from the 11 questions pertaining to each dimension. Each question asks a respondent to select one of two options that focus on some aspects of learning. When a respondent answers the question, on the one hand, by choosing "a", her or his score value will increase by 1. On the other hand, favoring "b" decreases the score value by 1. Option "a" corresponds to the active, sensing, visual, or sequential preference, and option "b" to the reflective, intuitive, verbal, or global preference.

For each dimension, the total score is calculated by adding all scores accumulated on the "a" side and subtracting it from the sum on the "b" side. The final score is expressed as either 1, 3, 5, 7, 9, or 11; scores of 1 or 3 indicate a balanced learning style, scores between 5 and 7 represent a moderate preference for one dimension, and scores of 9 and above show a strong partiality for one pole over its opposite [27]. The same formula applies to the other pole (negative scores).

4.5 Reliability and Validity of ILS

According to Felder and Spurlin [28], the ILS can be considered as a reliable, valid, and suitable instrument for assessing a students' learning style. Notably, many studies have evaluated the reliability and validity of the ILS [29-33], and, although some recommend continued research on the instrument, conclude that it offers a dependable and effective method to determine an individual's learning style.

5 Finding and Data Analysis

5.1 Demographic Analysis

A total of 162 respondents were involved in this survey. All of the participants were first-year students of a Vocational Secondary School from five different administrative subdivisions in Yogyakarta Province, Indonesia.

Figure 2: Distribution of respondents based on region

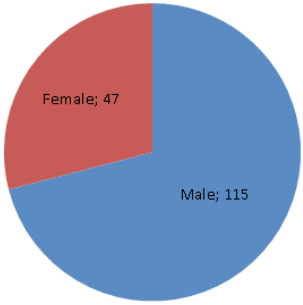

Figure 3: Distribution of male and female participants

The participants included 31 students each from Yogyakarta city and Sleman regency, 32 each from Gunung Kidul and from Kulon Progo regency, and the remaining 36 are from Bantul regency. Overall, 115 male students and 47 females participated in this survey. Figures 2 and 3 illustrate the distribution of participants based on region and gender, respectively.

5.2 Learning Style Preferences

Based on the mean score calculated in Table 1, one can notice that the students involved in this survey preferred the active, sensing, visual, and sequential learning styles. This finding corresponds to many studies conducted and summarized by Felder and Spurlin [28]. However, a closer examination of the sequential-global dimension shows that the students from two regencies (Yogyakarta city, 51.61%, and Sleman,

58.06%) are more global-type learners than sequential learners. Furthermore, the students from the Bantul regency return a balanced score on the sequential-global learning dimension. Table 1 also shows that based on the overall percentage recorded, the most preferred learning style is visual (83.83%), followed by active (82.66%), sensing (67.66%), and sequential (52.44%).

Table 1: Learning style preferences according to region

Region	Active (%)	Reflective (%)	Sensing (%)	Intuitive (%)	Visual (%)	Verbal (%)	Sequential (%)	Global (%)
Gunung Kidul	81.25	18.75	68.75	31.25	81.25	18.75	56.25	43.75
Kulon Progo	75.00	25.00	68.75	31.25	81.25	18.75	65.63	34.38
Bantul	86.11	13.89	75.00	25.00	88.89	11.11	50.00	50.00
Yogyakarta City	83.87	16.13	74.19	25.81	83.87	16.13	48.39	51.61
Sleman	87.10	12.90	51.61	48.39	83.87	16.13	41.94	58.06
Mean	**82.66**	**17.34**	**67.66**	**32.34**	**83.83**	**16.17**	**52.44**	**47.56**

5.3 Distribution and Strength of Learning Styles Preferences

The ILS classifies the scores into three levels of preference intensity towards a particular learning style: strong, moderate, and balanced. This survey's data were also calculated according to strength (Table 2). For the active-reflective dimension, the learning style of the students was more intensely active (82.66%) than reflective (17.34%). Even so, most participants were within the moderate and balanced levels, with only 10.06% in the strong position. In the sensing-intuitive dimension, sensing learners accounted for 67.66%, and the remaining 32.34% were intuitive learners. The most common type of students was visual, with a total percentage of 83.83, and the verbal type was the least common. For the sequential-global dimension, although the students leaned overall toward the sequential type instead of global, it is interesting that the margin for this preference was within 5%. Finally, the greatest percentage of both sequential- and global-type students was within the balanced strength level.

Table 2:Distribution of strength level on learning style

Strength Level	Active (%)	Reflective (%)	Sensing (%)	Intuitive (%)	Visual (%)	Verbal (%)	Sequential (%)	Global (%)
Strong	10.06	1.18	3.63	1.29	22.41	0	0	1.87
Moderate	35.49	2.52	25.61	9.38	33.85	2.52	15.32	8.77
Balanced	37.11	13.64	38.42	21.67	27.57	13.65	37.12	36.92
Total	**82.66**	**17.34**	**67.66**	**32.34**	**83.83**	**16.17**	**52.44**	**47.56**

5.4 Learning Styles Preferences based on Gender

It is interesting to analyze whether a significant difference exists among student learning styles when gender is the independent variable. For this purpose, a one-way multivariate analysis of variance (MANOVA) was performed on the four dimensions of the FSLSM, with each learning style as the dependent variable. By utilizing Wilks's Lambda criterion, results showed that gender affects the combined dependent variables: $F(4, 157) = 4.491$, where $p = 0.002$.

Table 3: ANOVA results of students' learning style based on gender

		Sum of Squares	df	Mean Square	F	Sig.
Active/Reflective	Between Groups	82.087	1	82.087	5.822	.017
	Within Groups	2255.913	160	14.099		
	Total	2338.000	161			
Sensing/Intuitive	Between Groups	87.679	1	87.679	5.155	.025
	Within Groups	2721.630	160	17.010		
	Total	2809.309	161			
Visual/Verbal	Between Groups	71.168	1	71.168	4.423	.037
	Within Groups	2574.289	160	16.089		
	Total	2645.457	161			
Sequential/Global	Between Groups	75.635	1	75.635	6.456	.012
	Within Groups	1874.414	160	11.715		
	Total	1950.049	161			

The ANOVA was conducted to examine the effect of gender on each individual dependent variable (see Table 3). The results indicate that there is a statistically significant effect of gender on the active-reflective dimension ($p = 0.017$), sensing-intuitive ($p = 0.025$), visual-verbal ($p = 0.037$), and sequential-global ($p = 0.012$).

Table 4: Means and Standard Deviations of learning style depending on gender

	Gender	Mean	Std. Deviation	N
Active/Reflective	Male	2.88	3.905	115
	Female	4.45	3.354	47
	Total	3.33	3.811	162
Sensing/Intuitive	Male	1.21	4.372	115
	Female	2.83	3.435	47
	Total	1.68	4.177	162
Visual/Verbal	Male	4.84	3.868	115
	Female	3.38	4.347	47
	Total	4.42	4.054	162
Sequential/Global	Male	-.17	3.632	115
	Female	1.34	2.838	47
	Total	.27	3.480	162

Table 4 reveals that even in the same pole females had higher mean scores in active and sensing than males. On the other hand, males show higher mean scores in visual than females do. Based on the means on the sequential-global dimension, males preferred global (M = -0.17) and females preferred sequential (M = 1.34).

6 Discussion and Conclusion

6.1 Discussion

This study was conducted in order to investigate the learning styles of vocational high school students majoring in computer network programs in the Yogyakarta Province, Indonesia. To assess this, the Index of Learning Style questionnaire developed by Felder and Solomon [24] was used to classify the learning styles of 162 respondents. This questionnaire was selected because it is specifically tailored for the engineering learning and teaching process, since the majority of programs in vocational training relate to engineering either in theory, practice, or both. The ILS questionnaire also identifies learning style in more detail, because it partitions styles into four dimensions: active-reflective, sensing-intuitive, visual-verbal, and sequential-global.

The overall results identify that the most commonly preferred style of learning for respondents is active, sensing, visual, and sequential. This outcome corroborates ILS response data tabulated by Felder and Spurlin [28] from several engineering institutions located in various countries (Brazil, Canada, Ireland, Jamaica, the United Kingdom, and the United States). This study's results are also consistent with research findings collected by Lee and Sidhu at other engineering institutions in Mexico, New Zealand, China, and Malaysia [34].

Calculations of this study also express that the highest score reached was of a visual type at 83.83%, followed by active, sensing, and sequential types at 82.66%, 67.66%, and 52.44%, respectively. This finding can provide beneficial recommendations for teachers in the learning and teaching process. Educators should be aware and prepared to engage with suitable media and methods that compliment a particular learning style. Hence, this study suggests for teachers at VSSS in the Yogyakarta Province to encourage students to actively process information through activity and discussion, to perceive ideas through facts and data, to receive knowledge visually through pictures and illustrations, and to use step-by-step learning to enhance information absorption.

Because visual is the most dominant type, teachers should take into consideration the use of optical media in the learning process. Material supported by images, graphics, diagrams, or flowcharts should be preferred over text-based information. As the information and communication technology (ICT) sector grows rapidly, the use of computer-aided media offers an attractive alternative for teachers to convey

information more attractively and understandably. In the context of computer-based learning and e-learning, Carmona et al. [35], Carver et al. [36], and Dung et al. [37] suggest inserting learning resources components such as images, video, and animation into course material to attract the attention of visual learners. Teachers can utilize ICT tools to create videos or animation models to better visualize engineering concepts. These tools also can be used to generate interactive simulation media that provide an opportunity for students to experiment prior to real situations. In the context of computer network programs, this study suggests Packet Tracer, designed by Cisco Systems, as relevant simulation and modeling software. Existing research shows that the use of Packet Tracer as a network simulation tool in the learning process can improve student understanding and reduce the gap between ideas learned from school and real work situations [38, 39].

Notably, this study's findings also demonstrate that the disparity between sequential and global learners is not significantly high among participants (52.44% compared to 47.56%). When considering the gender of respondents, a similar disparity remained. Mean scores reveal a learning style difference in the sequential-global dimension, with female students more often scoring as sequential-type learners compared to a preference for the global approach among male students. Although the survey found that the majority of students lean toward sequential thinking rather than global thinking, educators should realize that they must not focus solely on sequential learners to the detriment of global learners. As this dimension is nearly balanced, educators should combine the sequential and global teaching method by recognizing when a particular course topic can be provided in a step-by-step strategy or by applying a global teaching method.

The data in this survey also confirm that verbal (16.17%) is the least-preferred learning style for engineering students in the Yogyakarta Province. This finding emphasizes that engineering students are less interested in verbal material; consequently, teachers should put less emphasis on verbally presented information during the learning process in the field of engineering.

6.2 Conclusion

This study's results demonstrate that vocational high school students in the Yogyakarta Province prefer active, sensing, visual and sequential learning styles. During the subsequent discussion of this finding, the study provided advice for teachers to design education strategies and learning resources that address students' needs, which may help students to better understand a particular course and to improve academic performance. Because visual was the most preferred learning style, the use of media aids (pictures, diagrams, and flowcharts), as well as ICT-based media, such as video, animation, and simulation tools, can enhance the learning and teaching process.

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