

## **CORRELATES OF STUDENTS' PERFORMANCE IN STATISTICS<sup>#</sup>**

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*This study sought to investigate the factors related to performance, specifically in an educational statistics course of students enrolled in the Faculty of Educational Studies, Universiti Putra Malaysia. A random sample of second and third-year students were selected for the study. The Group Embedded Figures Test (GEFT) was used to gather data on students' learning style (Wilkins et al., 1977). The GEFT was used to assess the learning style of students as either field-dependent or field-independent. It was found that 81.2 per cent of the students were inclined towards field-dependent learning style whilst 18.8 percent were inclined toward field-independent learning style. A correlational analysis indicated that learning style was significantly correlated with performance. Twenty nine percent of the variance in students' performance was uniquely accounted for by the linear combination of learning style, gender, program of study, and age.*

The education literature overwhelmingly conveys the value of understanding development of thinking abilities among students at all age levels. It has been a national concern worldwide that the importance of thinking abilities may lead to getting a better paid job for the individual, to be able to compete better economically for the nation and for the people, to fit better within a changing and complex environment, hence, towards improvement of quality of life (Thomas, 1992). According to Simon (1980) thinking ability has also currently received a great deal of attention. One reason is that increasingly fast-paced changes in the society make it necessary for people to think for themselves and to solve novel problems.

As such, teaching faculty in all disciplines and at all levels of education shared a common goal, that is to develop in students their complex mental operations, the ability to be successful during their learning episodes as well as in the future careers. But, what are the ways of

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developing complex mental operations in students? The present research is an attempt to address this issue.

A review of the literature reveals several factors that have been found to influence learning process. Learning process encompasses two major concepts: Intelligence and cognition. Intelligence is usually measured using an Intelligence Quotient test which is the number that is used to determine the level of learning people are capable of achieving throughout their lives. The learner, child or adult, is seen as a being with genetically programmed, individual limit. On the other hand, cognition is termed as the process by which individual think and reason. It leads to the categorization of tasks, thinking and reasoning processes, and the products of thinking, but not people.

Associated with modern cognitive theories, Butler (1993) suggested that cognitive skills are at the centre of human information processing models of the cognitive sciences. A cognitive skill is a personal capability that has a distinctive history of quantitative and qualitative changes associated with learning process. Butler also suggested that human information processing is characterized by three levels: Basic capabilities, cognitive skills and meta-cognitive skills. Level one is associated with working memory capacity and speed of concept activation which is impervious to instructional intervention. Level two cognitive skills, are related to problem solving and decision making. These skills are capable of being acquired and then transformed from conscious control to automatic processes through training and experience and can be developed through instructions. Meta-cognitive skills are associated to goal setting and planning cognitive activity. It has been suggested that meta-cognitive skills can also be developed through instructions (Butler, 1993). While much often elaborated on the levels of information processing skills, this paper is concerned with only one of the three levels mentioned above, namely, cognitive skills.

A conceptual framework for this study was adapted from Torres (1993) that indicated interconnections of five major factors that contributed to developing complex mental operations or cognitive skills: (i) teacher-related variables; (ii) student-related variables; (iii) personal characteristics; (iv) learning styles; and (v) other factors.

Teacher-related factors consist of philosophical beliefs, preparation, cognitive expectations on assignments and tests, and instructional delivery. All these factors are influential in cognitive development or performance, as these will be measured in this study.

On the other hand, student-related factors such as their involvement in the learning process, motivation levels, and levels of interest and perceived values of the course have also profound influence on performance. Similarly, McKeachie (1980) maintained that students' personal characteristics also play an important role in their cognitive development. Several other student-related factors have been suggested to be contributive to students' cognitive development. Attributes such as gender, age, ethnicity, social economic status, and intelligence are such factors.

Another factor has also emerged from the literature on student cognitive development. The pertinent factor is learning style. Here, learning style is synonymous to cognitive styles. In general terms, learning style is referred to as "individual's general tendency to adopt a particular strategy in the process of learning" (Messick 1976). He also describes cognitive styles as "habitual modes of processing information". Learning style has been described by Gregorc (1979) as consisting of distinctive behaviors which serve as indicators of how a person learns from and adapts to his/her environment and this leads to clues of how a person's mind operates. It is maintained very strongly that individuals differ both in the features they choose for classification (styles of conceptualization) and in their orientation towards similarities or differences. When given a piece of information which may or may not be a defined category, some individuals are more ready than others to assign meanings or context to the information during episodes of the learning process.

Learning style research has been applied at an ever-increasing rate to the problems of education. It has been identified as an extremely important element in setting for improvement in the teaching and learning process in education (Claxton & Murrell, 1987).

Along the same line, field-dependent and field-independent learning styles have been cited as capturing greatest attention among cognitive styles studies and have the broadest application to educational settings (Enwhistle, 1988; Witkins, Moore, Goodenough, & Cox, 1977). The dimension field-dependence or field-independence is measured by giving a simple geometrical figure and a complex figure to a respondent. He/she is required to identify the simple figure in a complex figure as instructed. The task is rather similar to a children's puzzle in which, say, a 'hidden rabbit' is discovered as part of the foliage of tree. The ability to spot the embedded figure varies from individual to individual. Those that could spot almost immediately are those that are not distracted by the surroundings and are categorized as field-independent. Other individuals spend much longer even with the simple items. Witkins et al. (1977) argued that different scores on this test do not simply reflect perceptual skills. According to the authors the

underlying styles of thinking do exist and these differ from one individual to another. These styles have been labeled as articulated (field-independent) and global (field-dependent). The articulated, field-independent style involves analyzing and structuring incoming information whilst the global, field-dependent mode of operation accepts the totality of impressions. The authors' description of field-dependent is associated with the inability to impose structure, and can be inferred from incidental characteristics such as being sociable and having interest in other people. Field-independent students are found predominantly in science faculties. These students are also successful in other areas of study.

Studies by Cox (1977) suggested that students who preferred a field-dependent learning style tended to perceive the world globally, found it more difficult to solve problems, were highly sensitive and attuned to the social environment, tended to favour the "spectator approach" to learning. Additionally, students who preferred a field-dependent learning style were more extrinsically motivated and responsive to social reinforcement. Conversely, it was suggested that field-independent students tended to view the world more analytically, found it easier to solve problems, and were more likely to favor "inquiry" and independent study. In addition, field-independent students tended to facilitate their learning by constructing their own structure. They were also more intrinsically motivated and were generally unresponsive to social reinforcement.

As indicated in earlier, there are many interconnecting links to address the issue of students' performance particularly the two levels of human information processing, viz. basic capabilities and cognitive skills. However, this study sought to investigate the influence of learning style on the performance of students who registered for a quantitative course in the Faculty of Educational Studies, Universiti Putra Malaysia.

The purpose of the present study was to provide descriptions of teacher education students' learning styles and its influence on performance of students. Specifically this study was guided by the following objectives:

1. To describe selected personological characteristics of teacher education students.
2. To describe the learning style and performance of students in a quantitative course registered in the teacher education program.
3. To describe the correlation between learning style, performance, and selected personological variables.
4. To explain the influence of teacher education students' learning styles on the performance in a quantitative course.

## METHOD

### Sample

This is a descriptive correlational study on students enrolled in a compulsory course in the Teacher Education Program at the Faculty of Educational Studies. Three categories of variables were investigated, namely, the independent variables-learning styles, the variables of prime interest - performance as the dependent variable and several control variables such as gender, age, and program.

Second and third-year teacher education students who are enrolled in Educational Research and Statistics course (which is a compulsory course) were selected to participate in the study. These students were majoring in five different areas, viz. (i) Teaching of English as a second language, (ii) Teaching of Malay language as a first language, (iii) Physical Education, (iv) Home Economics, and (v) Agriculture Science. Coming from the various fields of Specialization, this group approximated the general population of teacher education students at the university.

The gender distribution of the second and third-year teacher education students enrolled in the Educational Research and Statistics course indicated that 41.5 per cent were male and 58.5 per cent were female. Students majoring in Agriculture Science make-up 8 per cent of the sample. Those from the Home Economics major make-up a 12 per cent, from the Physical Education major make-up a 29.1 per cent, from the Teaching of Malay language as a first language make-up 12.6 per cent whilst the teaching of English as a second language students make-up 38.3 per cent. The largest group distributed by major or field of specialization is the teaching of English as a second language. The mean age of the second and third-year students was 24.43 years with a standard deviation of 2.16 years.

### Instruments

#### *The Group Embedded Figures Test (GEFT)*

GEFT developed by Witkins, Oltman, Raskin, and Karp (1971) was used to assess the learning style of students as either field-dependent or field-independent. According to the authors, individuals scoring greater than 11.4 were considered to be leaning toward the field-independent learning style, while individuals scoring less than 11.4 were considered to be leaning toward the field-dependent learning style. The instrument consists of three sections, with the first section containing seven embedded figures, the second and the third sections each containing nine embedded figures. A

separate sheet of simple geometrical figures was also given. Participants were asked to identify a simple geometrical figure in a complex figure (embedded with the simple geometrical figure). The first section was given to provide practice session for the participants. Participants were instructed to work on the first section followed by the second and the third sections. The assessment of learning styles was based on correct identification of the simple geometrical figure in the complex figure from both the second and third sections. Students were asked to trace the simple figure using a pen or pencil on the complex figure. Maximum possible raw score on the GEFT was 18. The reliability of the GEFT, as corrected by Spearman Brown formula, has been found to be .82.

### *Semester Grades*

Semester grades for the course were used as performance measure (in this study also referred to as cognitive skills). The mean score of three tests taken by the students during the semester were considered. The items were gathered from test question banks for the course. The reliability estimate of .72 was obtained using Kuder-Richardson-21 as a measure. Other personal data were obtained from a short questionnaire.

### **Procedure**

Both data collection on students learning style and questionnaire soliciting personal information was conducted during one of the regular lecture sessions by one of the researchers. Students who did not turn up for that session were given a make-up session. Both sets of data were pooled yielding a sample size of 176.

Data were analyzed using SPSS for Windows. Descriptive statistics such as frequencies, central tendencies, variance, and range were used to characterize the data. A multiple linear regression analysis was used to explain performance (or referred to as cognitive skills). An alpha level of .05 was set a priori.

## **RESULTS**

Results showed that the mean score for students' learning style (GEFT) was 8.07 out of a total possible score of 18. The scores range from

5 to 15. Using the national norm (score of 11.4) as the cut-off point, as reported by Witkins, et al. (1977), the second and third-year students can be dichotomized as field dependent or field independent. Further data analysis showed that 81.2 percent of the students were inclined towards a field-independent learning style whilst 18.8 percent were inclined towards field-dependent learning style. The mean performance score obtained was 61.05 out of a total of 100 points.

Table 1

*Correlation matrix of variables.*

Variables	Gender	Major	Age	GEFT2	GEFT3	GEFT	Performance/ Cognitive skills
Gender	1.00	.06	.05	.19	.22	.23	.14
Major		1.00	.23	.36	.37	.41	.50
Age			1.00	-.26	.15	-.13	-.22
GEFT2				1.00	.62	.88	.37
GEFT3					1.00	.91	.52
GEFT						1.00	.51
Performance/ Cognitive skill							1.00

Table 1 illustrates a correlation matrix of variables examined. Investigation of the relationship between learning style and cognitive skills as measured through performance in the course over a semester is of prime interest. The analysis indicated that learning style was significantly correlated with,  $r(176) = .48(p < .05)$ . Other correlation coefficients analyzed were between age and performance  $r(176) = -.22(p < .05)$ ,

between gender and performance  $r(176) = .41$  ( $p < .05$ ), and between program and performance Cramer's  $V$  value =  $.50(p < .05)$ .

A partial correlational analysis was conducted. Results indicated that there is a moderate correlation between performance and learning style  $r(171) = .41(p < .05)$ . Personological data such as gender, program and age were held as control variables.

Using multiple regression analysis (Table 2), approximately 29 per cent of the variance in performance among the second and third-year students enrolled in the compulsory course was accounted for by the linear combination of learning styles, gender, program, and age,  $F(1,174) = 17.12$ , ( $p < .05$ ). An examination of the beta coefficient showed that the best predictor of performance was learning styles, followed by age. Gender and program of study did not help explain performance. However, jointly or in combination, the independent variables accounted for slightly over 28 per cent of the variation in performance.

Table 2

*Multiple regression analysis of performance on control variables and variables of interest (N= 176).*

Variables	<i>b</i>	<i>t</i>	<i>p</i>
<i>Control Variables</i>			
Gender	.038991	.584	.5597
Programme	.109581	1.520	.1304
Age	.138041	2.071	.0398
<i>Variable of Interest</i>			
Learning Style	.429951	5.909	.0000
(Constant)		8.455	.0000

$R^2 = .28592$ ;  $F(1,174) = 17.12$ ;  $p < .05$



## DISCUSSION

A moderate positive bivariate relationship ( $r = .50$ ) existed between learning style and performance of teacher education students. Approximately 25 per cent of the variance in students' performance are uniquely accounted for by learning style.

The findings suggest that as educators, we need to address the issue of learners' learning styles in promoting and improving performance among them. Hence, as educators one should be cognizant that learning style has much influence on performance, as it can be associated to actions (cognitive processing). As such, educators should construct educational environment conducive to provide actions or rigorous processing of learners' cognitive capacity. This means that educators need to plan and deliver instructions suitable to students' learning style. More planning of activity oriented and sequential presentations of learning materials will be necessary for students leaning towards field-dependent learning style. In addition more attention should be given to students leaning towards field-dependent as compared to field independent students. Instructors can provide modules and worksheets for the field-independent students for certain learning episodes while ensuring extra time to develop understanding for the field-dependent students.

In general, instructors should use a variety of teaching methods, curriculum materials and evaluation techniques in order to reach out to students of differing learning styles. Witkins et al. (1977) ascertained that field dependent students need pre-structured information, since they are less able to impose their own analytical frameworks. Hence, field-dependent students ought to be more successful with instructors who, on the other hand, have articulated thinking style.

These findings also suggest that teacher education students who are bound to be teachers could maximize their teaching performance by taking into account their pupils' learning styles and adopt planning and delivery suitable for the pupils. Initially, teacher education students should have their learning styles assessed. This knowledge should be important in their effort to understand both their own and the students' learning perspective. Dunn and Dunn (1979) suggested that instructors teach the way they learn, as such, eluding the importance of learning styles to development of basic and cognitive capabilities of students.

With a major portion of the variance unaccounted for by learning styles, other factors such as student-related factors, teacher-related factors; and other related factors such as, environmental settings, class size, and institutional size might enlighten further the issue to develop students'

complex mental operations that will allow them to be successful in their learning (be it classrooms, colleges, or universities) as well as their future career. Thus, further research should also seek to investigate these factors.

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