

**LEARNING STYLES AND ACHIEVEMENT OF STUDENTS
AT UNIVERSITAS TERBUKA
(INDONESIAN OPEN LEARNING UNIVERSITY)**

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ABSTRACT

Universitas Terbuka (Indonesian Open Learning University) provides learning environments to its students which are related to its role as an educational institution that applies distance education systems. Many researches have been conducted relating learning styles and academic achievement, but not many have used the distance education setting. This study was conducted both to identify students' responses on Kolb's Learning-Style Inventory (Kolb's LSI) and to measure the relationship between these responses and academic achievement.

Two hundred and sixteen students of the four faculties of Universitas Terbuka responded to the inventory. Between faculties, the students were significantly different in emphasizing three of the four basic scores (Concrete Experience=CE, Abstract Conceptualization=AC, and Active Experimentation=AE, $p < .05$) and the composite scores (AC-CE and AE-RO, $p < .05$). The non-significant difference was on Reflective Observation (RO). The differences on CE, AC, and AC-CE were mainly between students of the Faculty of Social and Political Science and students of the other faculties. The differences on AE and AE-RO were between education students and the other students. Within each faculty and within the total sample, only students of the Faculty of Social and Political Science did not differentiate the four basic scores significantly. All students tended to score higher on the AC than they did on the other scores, except for education students who scored higher on AE.


Distribution of learning styles was significantly dependent on faculty. The majority of students of three faculties and the total

sample were assimilators. The exception was that the majority of education students were convergers.


The significant differences on academic achievement were not associated with learning styles and faculties. Higher achievement levels were likely related to higher scores on AC (significant in Mathematics and in the total sample). Higher achievement levels which were related to higher scores on RO were found only in Social and Political Science. Education students tended to have higher achievement levels than did students of the other faculties.

The similarities between faculties found in this study (non differentiation on RO and higher on AC) were likely related to the learning environment at Universitas Terbuka. Relating LSI scores and the cognitive processes employed in learning will be helpful in understanding students' achievement at Universitas Terbuka.

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TABLE OF CONTENTS

ABSTRACT	ii
TABLE OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	x
ACKNOWLEDGMENTS	xi
 CHAPTER 1: INTRODUCTION	
Background to the Problem:	
- Learning Environment at Universitas Terbuka	2
- Learning Styles	6
Statement of the Problem	8
Purposes	9
 CHAPTER 2: REVIEW OF THE LITERATURE	
Learning	11
- Kolb's Experiential Learning Theory	12
- Learning in Distance Education	14
- Learning in Indonesia	18
Learning Styles:	
- Concepts and Definitions of Learning Styles	19
- Categorization of Learning Style Instruments	23
- Learning Styles in Distance Education	25

Kolb's Learning Styles:

- Kolb's Concepts on Learning Styles	26
- Characteristics of Kolb's Instrument as a Standardized Instrument	30
- Kolb's Learning Styles in Distance Education	33
- Kolb's Learning Styles in Non English Versions	35
- Kolb's Learning Styles and Academic Fields	36
- Kolb's Learning Styles and Achievement	39
- Summary of the Literature	40

CHAPTER 3: RATIONALE, DEFINITIONS, AND RESEARCH QUESTIONS

Rationale	41
Definitions	45
Research Questions	46

CHAPTER 4: METHOD

Overview	49
Instrumentation:	
- The Instrument	50
- Translation and Pilot Information	51
- Reliability and Validity of the Instrument	53
Respondents	54
Data Collection	54
Data Analysis:	
- Scores on LSI and Learning Styles	55
- Test of Significant Differences between Faculties on LSI Scores	55

- Test of Significant Differences within each Faculty and Total Sample on LSI Scores	55
- Learning Styles	56
- Learning Styles and Achievement	56

CHAPTER 5: RESULTS

Overview	58
Response Rate	59
Reliability and Validity of the Instrument	60
Basic Scores (Scores on CE, RO, AC, and AE)	62
Composite Scores (Scores on AC-CE and AE-RO)	62
Distribution of Learning Styles	64
Faculties' Learning Styles	64
Student Achievement (Grade Point Average)	66
Correlations among LSI Scores and GPA	67
Evaluation of Assumptions for Analysis	68
Differences in Learning Orientations (Scores on CE, RO, AC, and AE)	69
Differences in Abstract/Concrete and Active/Reflective (Scores on AC-CE and AE-RO)	74
Distribution of Learning Styles across Faculties	77
Students' Achievement and Learning Styles	77
Achievement between Abstract and Concrete Students and between Active and Reflective Students	78
Achievement between Education and Non-Education Students	80
Contextual Data	81

CHAPTER 6: DISCUSSION AND CONCLUSIONS

Discussion:

- Overview 82
- Normative Comparison of LSI Scores (Research Questions #1 and #4) 83
- Ipsative Comparison of LSI Scores (Research Questions #2 and #3) 87
- Learning Styles (Research Questions #5) 89
- Students' Achievement and Learning Styles (Research Questions #6 and #7) 92
- Achievement between Abstract and Concrete Students, and between Active and Reflective Students 93
- Achievement between Education and Non-Education Students 94
- Overall Interpretation: Kolb's Learning Styles and Educational System at Universitas Terbuka 95

Conclusions and Summary 105

REFERENCES 110

APPENDICES

- A: Results of Reliability Analysis using Cronbach' Alpha 115
- B: Results of Validity Analysis using Factor Analysis 116
- C: Demographic Data 117
- D: Implications and Recommendations 121

LIST OF TABLES

Table 1.	Responses to Kolb's Learning-style Inventory (Questionnaire)	61
Table 2.	Coefficient Alpha of Kolb's LSI	61
Table 3.	Means and Standard Deviations (<i>SD</i>) of the LSI Basic Scores (Scores on CE, RO, AC, and AE) With Different Faculties	63
Table 4.	Means and Standard Deviations (<i>SD</i>) of the LSI Composite Scores (Scores on AC-CE and AE-RO) With Different Faculties	63
Table 5.	Numbers and Percentages (in bracket) of Learning Styles With Different Faculties	65
Table 6.	Means and Standard Deviations (in bracket) of GPA With Different Faculties and Learning Styles	67
Table 7.	Correlations between Variables	68
Table 8.	Multivariate Analysis of Variance of CE, RO, AC, and AE as a Combined Dependent Variables by Faculty	70
Table 9.	Univariate Analysis of Variance of CE, RO, AC, and AE as Individual Dependent Variable by Faculty	70
Table 10.	Pairs of Faculties in which the Differences of CE, AC, and AE were Significant (Multiple Comparison LSD, $p < .05$)	71
Table 11.	Test of Differences of the Four Learning Orientations (CE, RO, AC, and AE) by Faculty	72
Table 12.	Pairs of Learning Orientations in which the Differences within each Faculty were Significant (Multiple Comparison LSD, $p < .05$)	73
Table 13.	Test of Differences of the Four Learning Orientations within the Total Sample	74
Table 14.	Pairs of the Learning Orientations in which the Differences within the Total Sample were Significant	74

Table 15.	Multivariate Analysis of Variance of AC-CE and AE-RO as a Combined Dependent Variable across Faculty	75
Table 16.	Univariate Analysis of Variance of AC-CE and AE-RO as Individual Dependent Variables across Faculty	75
Table 17.	Pairs of Faculties in which the Differences of AC-CE and AE-RO were Significant (Multiple Comparison LSD, $p < .05$)	76
Table 18.	Analysis of Variance of GPA across Faculties and Learning Styles	78
Table 19.	Differences of GPA between Abstract Students and Concrete Students	79
Table 20.	Differences of GPA between Active Students and Reflective Students	80
Table 21.	Analysis of Variance of GPA between Groups of Faculties (Education and Non-Education) across Learning Styles	81

LIST OF FIGURES

Figure 1.	Bloom's variables in the theory of school learning	41
Figure 2.	Bloom's variables in the theory of school learning modified for this study	42
Figure 3.	Kolb's Learning Styles	51
Figure 4.	Distribution of Learning Styles	65
Figure 5.	Average composite scores (AC-CE and AE-RO) for each Faculty and their places in the learning style quadrants	66

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CHAPTER 1: INTRODUCTION

Background to the Problem

Every educational institution is responsible for providing an optimum teaching-learning environment for its students. The Open Learning University of Indonesia, Universitas Terbuka, is such an institution and it has constantly strived to improve its service to its students by improving its academic and administrative systems. However, any university only contributes partly to the students' success. The other contribution comes from the students themselves, and this is related to many characteristics. The way the students learn is part of an overall process which interacts with the learning facilities provided by the institution. Universitas Terbuka as a distance university is acutely aware of this (Syahbuddin, 1990). One important characteristic that impacts in the learning environment is how a person approaches the learning task itself; according to Kolb (1981), students' learning styles are important determinants of their performances.

Any educational program or learning environment can be viewed as having an influence on learning generally. The learning environment of a distance education institution, such as

Universitas Terbuka, is described in this chapter. This distance learning environment may be influenced by many factors including the study programs and their requirements, learning materials, study groups, student evaluations (assessments), and the grading system. As well, the psychological construct, students' learning styles, is explored in this chapter. Exactly how the learning styles are expressed in the distance education environment is the thrust of the study.

Learning Environment at Universitas Terbuka

The educational philosophy of a distance-education institution has implications for the whole set of educational processes including the development of programs, courses, and learning materials, the decisions about the media to be used in delivering these materials, and the nature of academic and administrative support systems (Smith & Curran, 1989). The educational philosophy and roles of Universitas Terbuka (the Indonesian Open Learning University) are directly related to the purposes for its establishment.

Setijadi (1988) enumerated the reasons for both the establishment and the roles of Universitas Terbuka. Universitas Terbuka was established to provide better access to higher education, especially for recent graduates of senior high schools.

For example, there were only 82,000 places in government higher-education institutions for more than 486,000 applicants in 1986, and the number of senior high school graduates in 1986 was more than 900,000. Another role of Universitas Terbuka was to upgrade secondary-school teachers; it was a continuation of the short-term training program for secondary-school teachers in the 1970s and the distance-education project in 1981. The establishment of Universitas Terbuka was also meant to increase the participation rate of the young generation in higher education in areas demanded by the economic and cultural development of Indonesia. Beginning in 1990, Universitas Terbuka also became responsible for training elementary-school teachers.

Universitas Terbuka offers 13 bachelor-degree programs, eight two-year diploma programs, a three-year diploma program, three certificate programs, and two teaching-qualification programs in four faculties. It had 111,579 active students at the end of 1991. The only entry qualification for non-education faculties is any kind of senior high school diploma. For the Education faculty, the applicant is required to have a three-year diploma in a related field and to be a teacher in a junior high school.

At Universitas Terbuka, the main study materials provided for

the students are printed materials. These printed materials (modules) represent 96% of the course materials and are supplemented by materials on audio cassettes (2.0%), course programs on television (.5%) and radio (.5%), face-to-face tutorials (.5%), and satellite education system (.5%, not presently available). Universitas Terbuka provides a guide for module writing which contains both general and specific instructional objectives for module writers (contractual-basis staff).

The courseloads for bachelor-degree programs (non-education faculties) are between 96-108 units of core courses and between 30-60 units of elective courses. A one-unit course is a courseload for which students, on the average, can study the module in 40 hours in one semester (Universitas Terbuka, 1991). The manual for module writers states that a one-unit course consists of three modules. It is predicted that the students can comprehend 80% of one module in about 10 to 11 hours (One module for social science is about 40 pages, and for exact sciences it is about 25 pages which are typed with one and a half spaces.) (Suparman, 1988). According to Syahbuddin (1990), high achievers spend 22 hours a week and low achievers spend 19 hours a week in the month prior to the final exams.

The university encourages its students to study

independently. Independent learning is defined not only as studying alone but also as studying in a group with other students, asking someone else who knows more, listening to audio cassettes provided by the university, watching the course program on television, doing simulation, and finding relevant literature (Universitas Terbuka, 1991). The university also encourages the students to form study groups in order to motivate the students to study, to facilitate the students in studying with other students, to provide better access to information from the university for the students, and to provide a place for discussing and conducting academic and non-academic activities. The university helps the study group find a study room, provides correspondent tutorials, provides extra face-to-face tutorials, and gives guidance for conducting activities.

Student evaluations are in the form of home assignments, final examinations, and comprehensive examinations. There are formative tests in each module. The home assignments and the final examinations consist of multiple-choice questions. There are examinations for some courses in essay question form in Education and in Mathematics and Natural Science based on the number of the students registered for examinations (less than 100 students) or on the difficulty level of the individual courses.

The final grade of a course derives from the home assignments (20%) and from the final examinations (80%), or 100% from the final examination without the home assignments. The grading system employed at Universitas Terbuka is: A (4 = very good), B (3 = good), C (2 = average), D (1 = less than average), and E (0 = fail). Students are allowed to take comprehensive examinations after they have taken a number of units which is 15 units less than the required number of units (all units for Education), have earned GPAs of not less than 2.00, and have gained final grades of at least C in the State Ideology course.

Learning Styles

There are various concepts of learning styles which predict wide variations in the scale and the scope of learning, of achievement, and of other behaviors (Curry, 1990). In 1983, Curry categorized learning style concepts and measurement approaches into three categories: Instructional Preference (individual's choice of environment in which to learn); Information Processing Style (individual's intellectual approach to assimilating information); and Cognitive Personality Style (individual's approach to adapting and assimilating information which does not interact directly with the environment).

The definition of learning style from the National Association of Secondary School Principals includes three behaviors: cognitive (information processing habits); affective (motivationally-based processes); and physiological (biologically-based responses). Keefe (1987, p. 5) defined learning style as "characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment".

The learning style concept and the instrument used in this study were based on Kolb's experiential learning model. Curry (1983) described Kolb's learning-style inventory as measuring information processing. Ferrell (1983), using Keefe's conceptualization of factor analysis, suggested that Kolb's learning style inventory tended to emphasize cognitive behaviors. Kolb (1984) conceptualized learning as a four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation. His learning-style instrument measures the learners' relative emphasis on each of these stages or modes. Concrete experience and abstract conceptualization are the opposite sides of the same dimension. In the other dimension are active experimentation and reflective observation. According to Smith and Kolb (1986),

these two dimensions are statistically independent. The four quadrants of these two dimensions are the four types of learning styles: accommodator, diverger, assimilator, and converger.

There are five forces that shape an individual's learning style: personality type, educational specialization, career choices, current job role, and current task (Kolb, 1984; Smith & Kolb, 1986). According to Kolb, undergraduate education is a major factor in the development of someone's learning style. It is reasonable to assume that different learning styles are found in different undergraduate majors. The implication is that any educational program, as part of a learning environment may create degrees of orientation toward concrete experience, reflective observation, abstract conceptualization, and active experimentation. It may be that the particular learning environment created by Universitas Terbuka influences both the students' learning styles and the students' performance.

Statement of the Problem

Kolb (1984, p. 38) defined learning as the "process whereby knowledge is created through the transformation of experience" (p. 38). His first emphasis was on the process of adaptation and learning as opposed to content or outcomes. The role of Universitas Terbuka is not only to provide better, or widening,

access to higher education, but also to provide the more skilled human resources which are demanded by the economic and cultural development of Indonesia and which will be associated with the program completion rate of the students. As such, the role of Universitas Terbuka may be described as being critically involved in the "process of adaptation".

The problem, however, is both that there is little general literature on learning styles in distance education universities and that there are few researches at Universitas Terbuka which have specifically looked at the learners themselves. For example, a search of the literature between 1966 and 1981 indicates no research on learning style in distance education. Between 1982 and 1992, however, 20 pieces of research on learning style in distance education were published in North America. A further examination of the literature reveals that only 8 of 20 studies were exclusively related to learning style; the others were parts of other researches or evaluations.

It makes empirical sense, therefore, to explore the learning styles of students in a distance education university, like Universitas Terbuka.

Purposes

The purposes of this study are: 1) to identify whether there

are any differences between faculties, within each faculty, and within the total sample (Universitas Terbuka) associated with the scores on Kolb's Learning-style Inventory; 2) to identify students' learning styles at Universitas Terbuka; and 3) to determine whether there is a relationship between the components learning style and achievement.

CHAPTER 2: REVIEW OF THE LITERATURE

Learning

Epistemology is the branch of philosophy that is concerned with the nature of knowledge. Two opposing positions on this matter are rationalism and empiricism. Rationalism stresses the activities of the mind in explaining the nature of knowledge, and empiricism stresses the importance of sensory experience as the basis of all knowledge (Hergenhahn, 1988). The division of learning theories based on these two opposing propositions by Bower and Hilgard (1981) are behavioural-associationist theories (empiricism) and cognitive-organizational theories (rationalism).

According to Bower and Hilgard, it is difficult to frame a definition of learning that adequately covers all diverse forms of learning. A satisfactory definition typically is derived from how the phenomena in question are viewed. Even though the major source of difference between learning theories is not the definition, but the interpretation, Bower and Hilgard provide a possible definition of learning as follows:

Learning refers to the change in a subject's behaviour or behaviour potential to a given situation brought about by

the subject's repeated experiences in that situation, provided that the behaviour change cannot be explained on the basis of the subject's native response tendencies, maturation, or temporary states (such as fatigue, drunkenness, drives, and so on).

(Bower and Hilgard, 1981, p.11).

A similar definition of learning was given by Hergenhahn (1988) with an emphasis on the change as a relatively permanent change. He defined behavioural potentiality as the ability to perform some act, although the act is not being performed at the present time. The translation of this potentiality into behaviour is the performance.

Kolb's Experiential Learning Theory

Kolb's (1984) view is termed experiential learning theory. It is not considered the third alternative either to behavioural learning theories (based on an empirical epistemology and denying any role of consciousness and subjective experiences in the learning process) or to rationalist and other cognitive learning theories (based on a rational and idealist epistemology and giving primary emphasis to acquisition, manipulation, and recall of abstract symbol). Kolb's model provided "a holistic integrative perspective on learning that combines experience, perception, cognition, and behaviour" (Kolb, 1984, p. 21).

Kolb's definition of learning was that "learning is the process whereby knowledge is created through the transformation of experience" (p. 38). His definition of experiential learning was based on the Lewinian model, Dewey's model, and Piaget's model. These characteristics were:

- learning is best conceived of as a process, not in terms of outcomes (concepts are derived from and continuously modified by experience);
- learning is a continuous process grounded in experience (knowledge is continuously derived from and tested out in the experiences of the learner);
- the process of learning requires the resolution of conflicts (conflicts between concrete experience and abstract conceptualization; and between active experimentation and reflective observation);
- learning is a holistic process (experiential learning is a molar concept describing the central process of human adaptation to the social and physical environment, integrated and inter related functioning of the total organism: feeling, thinking, perception, and behaviour);
- learning involves the transactions between the person and the environment (as opposed to a person-centered psychological view and a limited environment of books, teachers, and

classrooms);

-learning is the process of creating knowledge (understanding in learning is accomplished by understanding the nature and forms of human knowledge and the process whereby this knowledge is created).

The process of experiential learning includes a four-stage cycle of learning modes: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). The cycle is that immediate or concrete experience (CE) is the basis for observations and reflections (RO). These observations and reflections (RO) are assimilated and distilled into a theory or concept (AC) from which new implications for action can be drawn (AE). These implications (AE) can be tested and serve as guides in creating new experiences (CE) (Smith and Kolb, 1986).

Learning in Distance Education

Keegan (1990) described "learning at a distance", or "distance learning" and "distance teaching", as two parts of the process in "distance education". He related the term "distance education" to other terms used in other places (such as "correspondence education" or "correspondence study" [United Kingdom]; "home study" and "independent study" [United

States]; "external studies" [Australia], and "distance teaching" or "teaching at a distance" [Open University of the United Kingdom]). He defined distance education as a generic term that included the range of teaching-learning strategies of these terms.

Based on his review of several definitions, Keegan described distance education as the form of education that is characterized by:

the quasi-permanent separation of teacher and learner throughout the length of the learning process (this distinguishes it from conventional face-to-face education);

the influence of an educational organization both in the planning and preparation of learning materials and in the provision of student support services (this distinguishes it from private study and teach-yourself programs);

the use of technical media (print, audio, video or computer) to unite teacher and learner and carry the content of the course;

the provision of two-way communication so that the student may benefit from or even initiate dialogue (this distinguishes it from other uses of technology in education);

the quasi-permanent absence of the learning group throughout the length of the learning process so that

people are usually taught as individuals and not in groups, with the possibility of occasional meetings for both didactic and socialization purposes.

(Keegan, 1990, p. 44).

Distance learning, or learning at a distance as half of the process in distance education, was described by Keegan (1990) as the process that is seen by the learners. There are five key areas found in the research of student learning that might be significant for distance education (Morgan, 1991). These five key areas are students' orientation to learning, students' development as learners, approaches to study, the content of learning or the learning outcomes, and students' experiences of course design and assessment.

Morgan considered the students' experiences of course design and assessment (e.g. assessment which emphasizes reproduction of information can lead the students to adopt surface approaches to study) to be the area where distance educators and educational technologies were able to influence the ways in which students approach their studies. According to Dewal (1988), most distance-education institutions provide only printed materials as the study materials. Three of the four distance-education institutions in Asia analyzed by Smith and Curran (1989) placed the greatest emphasis on printed

materials. At Universitas Terbuka, printed materials represent 96% of the total study materials received by the students.

Marland, Patching, Put, and Store (1984) viewed learning from printed material as "a direct consequence of the mental activities a student engages in after encountering or identifying a feature in the text regarded as valuable, interesting, or puzzling" (p. 217). Because printed material is still a staple ingredient in many distance teaching programs, Marland (1989) developed a paradigm suitable for research on learning at a distance, particularly from textual materials. In his paradigm, there are the components of the learner (e.g. education orientation, study orientation, and learning style), components of the printed material (e.g. style, typography), and components of the contextual variables (e.g. family life and work environment). These components and the interactions among them shape the mediating (or cognitive) processes and influence outcomes.

Distance learners are different from on-campus learners since their instructional programs and materials, their learning context, and their problems differ markedly from those of the on-campus learners (Marland, 1989). Wong (1992) also indicated that external students appeared to show significant differences from internal students in approaches to study or learning style; he suggested that these differences might be due

both to different learning environments and to age distribution. It is widely accepted that the distance learner must study independently. Smith and Curran (1989) proposed a compromise between dependence and independence. They suggested that distance education should develop interdependent learners who enjoy a certain amount of autonomy in choosing their learning strategies and where and when to study, but who are expected to interact from time to time directly with their academic mentors and fellow students.

Learning in Indonesia

This review is based on the work of Dunbar (1991) who suggested that the learning behaviours of Indonesians in general contribute to the problems of Universitas Terbuka in adapting a course development and course delivery system established in Western countries.

Dunbar suggested that Indonesians have a strong oral tradition. Reading and writing are widely unpopular and not highly valued either as a means of gaining or communicating knowledge or as a source of personal improvement. Moreover, Dunbar indicated that, in certain circumstances, book reading can be regarded as anti-social and isolationist behaviour. The Indonesian people overwhelmingly prefer interpersonal

communication to solitary and concentrated acts of reading and writing.

In relationship to face-to-face education as the only common education in Indonesia, learners seek approval and direction. Learning is a communal and passive activity, and the "limits" of learning are prescribed by teachers. The acquisition of knowledge is by means of passive replication and rote memorization, and it typically excludes the cultivation of active individual enquiry.

Learning Style

Concepts and Definitions of Learning Style

Widespread agreement has supported the existence of individual differences in learning styles, but researchers have often defined the concept of learning styles differently (Dunn and DeBello, 1981). Curry (1990) supported this statement by indicating that there were various concepts and constructs regarding learning style. The different constructs or concepts lead to a wide variation in instrument development. One implication is that achievement and learned behaviour are viewed in many different ways.

The National Association of Secondary School Principals

defined learning style as including three behaviours: cognitive (information processing habits); affective (motivationally-based process); and physiological (biologically-based responses). Keefe (1987, p. 14) defined learning style as "characteristic cognitive, affective, and physiological behaviours of how learners perceive, interact with, and respond to the learning environment". Keefe elaborated each of the behaviours. Cognitive style consists of the information processing habits representing the learner's typical mode of perceiving, thinking, problem solving, and remembering. Affective style encompasses aspects of personality that have to do with attention, emotion, and valuing. Physiological style is biologically-based modes of response that are founded on sex-related differences, personal nutrition and health, and "accustomed" reaction to the physical environment.

Curry (1983) reconceptualized learning style models based on psychometric standards. His concept consisted of three layers of learning behaviour. The outermost layer, and the most observable, is "Instructional Preference". This refers to the individual's choice of an environment in which to learn. The second layer is "Information Processing Style". This style is conceived of as the individual's intellectual approach to assimilating information following the information processing model. The innermost layer is "Cognitive Personality Style". It

is defined as the individual's approach to adapting and assimilating information. The adaptation does not interact directly with the environment. It is an underlying and relatively permanent personality dimension.

Guild and Garger (1985) divided style differences into cognition (perceiving and gaining knowledge differently), conceptualization (forming ideas and thinking differently), affect (feeling and forming values differently), and behaviour (acting differently as the manifestation of the other three styles). There are three ways, therefore, that learning style has been viewed: as a structure; as a process; and as both a structure and a process (Riding and Cheema, 1991). The focus in viewing learning style as a structure is on its stability over time, and the implication is that the learning environment should be created to match individual differences. This view is similar to what Curry conceived of as cognitive personality style. As a process, the focus is on how the style changes (the learning environment may try to foster the change and reduce the weaknesses). As both structure and process, style is relatively stable and is continually modified as new events influence it directly or indirectly. In viewing the cognitive style as an element, learning style is a bipolar dimension (between wholist and analytic, and between verbalizer and imager).

There are a number of definitions that are related to the terms of learning styles. According to Keefe and Ferrell (1990), some attempts have been made to correlate the definitions of styles. Comparing learning styles and cognitive styles, Keefe and Ferrell (1981) classified cognitive style as a type of learning style. Keefe stated (1979) that learning style is a broader term that includes cognitive, affective, and physiological style. Curry (1990) reviewed the terms of learning style, learning strategy, and learning tactic. He found that style refers to information processing routines that function in a trait-like manner at the personality level. Strategy is defined as cross-situational consistency in how the students approach school learning, and tactic is described as the specific and observable activity of learners in a specific learning situation. To distinguish style from strategy, Riding and Cheema (1991) described style as a fairly fixed characteristic, while strategy is described as a way which may be used to cope with situations and tasks; it varies from time to time, and may be learned and developed. Boyatzis and Kolb (1991) defined skill in a way similar to the definition of strategy by Riding and Cheema. In relation to ability, Messick (1976) defined style as the manner in which behaviour occurs or bears on the questions of how; he defined ability as the dimension that essentially refers to the content of cognition or

the questions of what.

Categorization of Learning Style Instruments

Many instruments designed to measure learning style have been developed, and they are supposed to measure the same construct. However, simply looking at the instruments reveals that they are quite different in form, length, language, and conceptualization (Ferrell, 1983).

Curry (1983), based on his conceptualization, categorized nine learning style instruments. The instruments which were on the model of Instructional Preference were: the Instructional Preference Questionnaire (by Stritter and Friedman), the Learning Preference Inventory (Rezler), and Grasha-Riechmann Student Learning Style Scales (Riechmann and Grasha). The instruments based on the model of Information Processing Style were the Learning Style Inventory (Kolb), Cognitive Preference Inventory (Tamir, Elstein, and Molidor), and the Inventory of Learning Preference (Smeck and Ribich). The instruments categorized into the Cognitive Personality were the Embedded Figure Test (Witkin), the Myer-Briggs Indicator (McCaully), and the Matching Familiar Figure Test (Kagan).

Ferrell (1983) and Karer (1988) categorized learning style instruments based on Keefe's conceptualization (cognitive,

affective, and physiological). Both Ferrell and Karer (analyzing six instruments) categorized Kolb's Learning Style Inventory (LSI) into cognitive style (information processing). In the categorization by Guild and Garger (1985), Kolb's LSI was in the conceptualization category (thinking, forming ideas, processing, and memory). Meanwhile, Riding and Cheema (1991), whose differentiation was between style and strategy, categorized Kolb's LSI as a learning-strategy instrument. For style, they categorized the instruments into wholist-analytic and verbalizer-imager styles.

Categorization of instruments, according to Riding and Cheema, in a bipolar dimension are: Wholist-analytic-style instruments (Field dependence-independence by Witkin, Impulsivity-reflectivity by Kagan, Holist-serialist by Past, Leveller-sharpener by Holzman and Klein, Simultaneous-successive by Das, Diverging-converging by Hudson, and Tolerant-intolerant by Gardner); and Verbalizer-imager-style instruments (Sensory modality by Barlett, Verbalizer-imager by Riding and Taylor, and Verbalizer-visualizer by Richardson). The surface and deep approaches to study were included in the wholist-analytic style.

Some known learning-style instruments mentioned by Dunn and DeBello (1981) are the Learning Style Inventory (Canfield and Lafferty), the Learning Style Inventory (Dunn, Dunn, and

Price), the Transaction Ability Inventory (Gregorc), the Cognitive Style Interest Inventory (Hill), the Teacher Assessment of Student Learning Styles (Hunt), and the Child Rating Form (Ramirez and Castaneda).

In summary, how learning style is defined and measured varies greatly among researchers.

Learning Style in Distance Education

Pigg, Busch, and Lacy (1980), Theil (1984), Fox (1984), Vondrell and Sweeney (1989), and Dille and Mezack (1991) have used Kolb's LSI for conducting research on learning style in distance education (adult education, independent study, and self-directed study). The results of these researches are provided in the section of "Kolb's Learning Styles in Distance Education".

Research on learning styles in distance education which did not use Kolb's LSI were conducted by Danielson and Seiler (1979), Harper and Kember (1986), Coggins (1988), and Wong (1992). Both Harper and Kember, and Wong compared external and internal students and used the same instrument (Approaches to Studying). The results of both researches indicated that external students had higher scores for interrelating ideas and deep approach. However, Danielson and Seiler (1979) did not find any significant difference in

understanding level questions between field-independent students and field-dependent students. They were, however, significantly different in rote questions (achievement levels of field-independent students were higher). Coggins (1988) found significant differences between completers and non-completers in the area of preferred content (preferences for numerics, language, objects, and people).

Kolb's Learning Style

Kolb's Conceptualization of Learning Style

Kolb (1984) believed, as he indicated in his experiential learning model, that people learn through experience and that the process is a four-stage cycle of learning modes: concrete experience (CE, sample word = feeling), reflective observation (RO, watching), abstract conceptualization (AC, thinking), and active experimentation (AE). His instrument (Learning Style Inventory) measures an individual's relative emphasis on each of the four learning modes (the basic scores) and the extent to which the individual emphasizes abstractness over concreteness (AC-CE) and action over reflection (AE-RO) as the combination or composite scores.

Kolb (1985), in the Interpretation Booklet for his

instrument, defined the four learning modes as follows:

Concrete Experience (CE, learning from feeling):

This stage of the learning cycle emphasizes personal involvement with people in everyday situations. In this stage, learners would tend to rely more on their feelings than on a systematic approach to problems and situations. In learning situations, they would rely more on their ability to be open minded and adaptable to change.

Reflective Observation (RO, learning by watching and listening):

In this stage of the learning cycle, learners understand ideas and situations from different points of view. In a learning situation they would rely on patience, objectivity, and careful judgment, but would not necessarily take any action. They would rely on their own thoughts and feelings to form opinions.

Abstract Conceptualization (AC, learning by thinking):

In this stage, learning involves using logic and ideas, rather than feeling, to understand problems or situations. Typically, learners would rely on systematic planning and develop theories and ideas to solve problems.

Active Experimentation (AE, learning by doing):

Learning in this stage takes an active form - experimenting with influencing or changing situations. Learners would have a practical approach and a concern with what really works, as opposed to watching a situation. They value getting things done and seeing the results of influence and ingenuity.

(Kolb, 1985, p. 5).

Effective learners need the four different abilities: "they must be able to involve themselves fully, openly, and without bias in new experiences (concrete experience), to reflect on and observe these experiences from many perspectives (reflective observation), to create concepts that integrate their observations into logically sound theories (abstract conceptualization), and to use these theories to make decisions and solve problems (active experimentation)" (Smith & Kolb, 1986, p. 12).

Concrete experience and abstract conceptualization are bipolar opposites of one dimension, and active experimentation and reflective observation and active experimentation are polar opposites of the other dimension. These two dimensions are statistically independent. The combination of resolving the two conflicts between abstract-concrete and active-reflective indicates reliance on each of the four types of learning styles: accommodator (reliance on apprehension or CE and transformed by extension or AE), diverger (CE and RO), assimilator (AC and RO), and converger (AC and AE) (Kolb, 1985).

The description of the characteristics of the four learning styles are as follows:

Accommodator (combination of learning steps of concrete experience and active experimentation):

People with this learning style have the ability primarily for "hands-on" experience. They enjoy carrying plans and involving themselves in new and challenging experiences. Their tendency may be to act on feeling rather than logical analysis. In solving problems, they may rely more heavily on people for information than on their own technical analysis. This learning style is important for effectiveness in action-oriented careers, such as marketing or sales.

Diverger (combination of learning steps of concrete experience and reflective observation):

People with this learning style are best at viewing concrete situations from many different points of view. Their approach to situations is to observe rather than to take action. They enjoy situations that call for generating a wide range of ideas, as in a brainstorming session. They probably have broad cultural interests and like to gather information. This imaginative ability and sensitivity to feeling is needed for effectiveness in the arts, entertainment, and service careers.

Assimilator (combination of learning steps of abstract conceptualization and reflective observation):

People with this learning style are best at understanding a wide range of information and putting it into concise, logical form. They probably are less focused on people and more interested in abstract ideas and concepts. Generally, people with this learning style find it more important that a theory has logical soundness than practical value. This learning style is important for effectiveness in information and science careers.

Converger (combination of learning steps of abstract conceptualization and active experimentation):
People with this learning style are best at finding practical uses for ideas and theories. They have the ability to solve problems and make decisions based on finding solutions to questions or problems. They would rather deal with technical task and problems than with social and interpersonal issues. These learning skills are important to be effective in specialist and technology careers.

(Kolb, 1985, p. 7).

Characteristics of Kolb's Instrument as a Standardized Instrument

Objectivity, conditions of administration, normative data, validity, and reliability are considered to be the characteristics of a standardized instrument used in educational research (Borg and Gall, 1989). Borg and Gall described objectivity as the degree to which the instrument is influenced or distorted by the beliefs or biases of the individual who administers and scores it. The conditions of administration are related to the time allocated for doing the test, penalties for guessing, repetition of instruction, answering the questionnaire, and interaction between the testers and the subjects. In some tests, individual scores were related to the performance of a group called the test norm (normative data). The degree to which a test

measured what it purports to measure is the validity of the test and the degree of the consistency of measurement is the reliability of the test.

Researches on evaluating standardized instruments have generally centered on the reliability and validity of the instrument. The objectivity of Kolb's LSI was indicated by the force-choice ranking format of the instrument and, as indicated by Smith and Kolb (1985), there is no right or wrong answer. It takes about ten minutes to complete the test. The Interpretation Booklet (Kolb, 1985) and the User's Guide (Smith and Kolb, 1986) provided the normative data from a sample of 1,446 adults between the age of 18 and 60 (801 women and 638 men). The sample was ethically diverse and represented a wide range of career fields.

There has been research on the reliability and validity of the Kolb's LSI. Freedman and Stumph (1980) considered Kolb's LSI to be unreliable as indicated by a low test-retest reliability ($r = .50$) and coefficient alpha of the four basic scores between $.40 - .70$. Research which indicated low-to-moderate reliability coefficients was conducted by Katz (1988; between $.40$ and $.59$); and Sims, Veres, Watson, and Buckner (1986; $.23 - .58$). Moderate reliability coefficients were reported by Marshall and Merritt (1985; between $.55$ and $.72$) and by Merritt and Marshall

(1984; .546 - .725). Marshall and Merritt (1986) reported high reliability coefficients (.78 - .88). Kolb (1981) reported the reliabilities of five samples between .55 and .82. His results revealed that the coefficient reliabilities of the two combination scores were the highest and were consistent across all five samples. In 1985, Kolb revised his instrument. The reliability of this revised instrument was reported by Sims et al. (1986) at between .76 and .85. In the User's Guide, the reliabilities were between .82 and .88 (Smith & Kolb, 1986). According to Kline (1983), a reliability coefficient of .70 or larger is necessary for an instrument to be considered satisfactorily consistent and there is no reason to use an instrument with reliability lower than .50.

The support for the validity of the LSI was based on the idea both that the instrument is a self-descriptive inventory which is based on what people say they do (eliminating the motivation that tends to distort the self-report instrument) and that people are fairly accurate self-perceivers (Smith and Kolb, 1986). The results of validity tests for Kolb's LSI conducted by Merritt and Marshall (1984), Marshall and Merritt (1985), Marshall and Merritt (1986), and Katz (1988) indicated that the instrument is valid. Ferrell (1983) found that the instrument measured cognitive behaviour (not including the affective and physiological aspects of Keefe's conceptualization). However, the results of

factor analysis of his study on the instrument supported Kolb's conceptualization on learning style. Highhouse and Doverspike (1987), however, considered that Kolb's LSI measured preferences more than it did cognitive style. Two of the seven researches using Kolb's LSI as a predictive instrument indicated that the instrument had a high predictive validity. The other researches indicated a qualified predictive validity (two of seven) and a non-predictive validity (three of seven) (Hunsaker, 1981).

Kolb's Learning Style in Distance Education

The LSI has been used in some case to measure the styles of distance learners. Interestingly, distance learners were defined as people involved in independent study, continuing education, self-directed learning, adult education, and telecourse study. For example, Vondrell and Sweeney (1989; independent study) and Dille and Mezack (1991; telecourse study) identified a variety of learning styles and found that the most prevalent style was assimilator. A study by Pigg, Busch, and Lacy (1980; adult education) indicated accommodator to be the most prevalent style.

Vondrell and Sweeney (1989) used Kolb's LSI for the identification of adults' success in an independent study program. Their results revealed that accommodators and

convergers tended to do quite well, assimilators performed close to these two styles, and divergers did significantly worse than did the total group. Theill (1984) found that the majority of successful self-directed learners had accommodator learning styles, followed by assimilators and convergers. Diverger was the least prevalent style. However, Dille and Mezack (1991) did not find the learning style to be a significant variable in predicting success or non-success in the telecourse study (printed materials as the major portion of the course and video programs on television as complements). Dille and Mezack not only used the types of learning styles, but also the LSI scores in their study. They found that scores on CE and AC-CE were significant predictors.

In continuing education for health professionals, Fox (1984) compared the learning styles of the participants with their evaluative statement about the program and their attitudes toward lectures in order to evaluate the construct validity of the instrument. The results did not indicate any difference on the evaluative statements and on the attitudes toward lectures as a function of different learning styles. Pigg et al. (1980), whose subjects were students of four program areas, found that the inventory provided a potentially useful framework for designing and conducting an adult education program despite minimal

correlations between learning styles and preferences for particular educational techniques.

Kolb's Learning Styles in Non-English Versions

The Kolb's Learning Style Inventory has been used in at least three other languages. These languages were Hebrew, German, and French.

The Kolb's LSI in the Hebrew version, used in Israel, was employed by Katz (1988). His study included undergraduate students with 9 different majors in two universities and two professional groups. The results revealed that the Hebrew version was as reliable as the English version, and the internal consistency coefficients were similar to the U. S. A. data. The construct validity verified the underlying structure of the model, and the instrument differentiated undergraduate majors in accordance with the theory.

The German version used in Switzerland was reported by Karer (1988). He indicated a validity comparable to the U. S. A. data. Theill (1984) used Kolb's LSI to investigate the learning styles of successful self-directed learners in Montreal. This French version was validated by a jury composed of adult educators. Given these data, it seems fairly safe to employ the LSI in yet another cultural context.

Kolb's Learning Styles and Academic Fields

One of the characteristics of experiential learning, according to Kolb (1984, p. 36), is that "learning is the process of creating knowledge". To understand learning, people must understand the nature and form of human knowledge and the process whereby this knowledge is created. Kolb related his learning process (abstract-concrete and active-reflective dimensions) to the structure of knowledge (analytic-synthetic dimension and dispersive-integrative dimension) and the structure of fields of inquiry (quantitative scientific - qualitative humanistic dimension and applied - basic dimension). The four quadrants and the relationship were: accommodation (Kolb's learning process) = contextualism or pragmatism (structure of knowledge) = social professions (fields of inquiry); divergence = organicism or absolute idealism = humanities and social science; assimilation = mechanism or materialism = natural sciences and mathematics; and convergence = formism or realism = science-based professions.

Kolb (1984) also analyzed the study conducted by Biglan and by Carnegie Commission. Biglan (1973) categorized 36 academic specialities based on a soft(concrete)-hard(abstract) dimension and an applied(active)-basic(reflection) dimension. The Carnegie Commission grouped 45 academic fields based on

the dimensions between the importance of humanities (concrete) and mathematics (abstract), and between the strong influence of the discipline outside the academic setting in providing consultation (active) and no influence (reflective).

Kolb concluded that the two basic dimensions of experiential learning theory, abstract-concrete and active-reflective, are the major dimensions of differentiation among academic disciplines. His typology of academic discipline was similar to the structure of inquiry. For example, in the accommodation quadrant, there are social professions such as education, social work, and law. The divergence quadrant encompasses the humanities and social sciences. The assimilation quadrant clusters natural sciences and mathematics, and the convergence quadrant includes science-based professions (mostly the engineering fields).

Kolb (1981 & 1984) reported the findings of his study on the learning styles (average scores on AC-CE and AE-RO) of undergraduate majors as follows:

- Accommodators: Business ($n = 67$).
- Assimilators: Foreign language (16), Economics (91), Mathematics (34), Sociology (15), Chemistry (27), and Physics (21).
- Convergers: Nursing (13) and Engineering (234).
- Divergers: History (34), Political Science (24), Psychology (24),

and English (30).

Some fields are multidisciplinary and encompass specialties that emphasize different learning styles. Several of the social sciences, especially psychology, sociology, and economics, can vary greatly in their basic inquiry paradigm (Kolb, 1984). Interestingly, in a technological university, there was a lack of significant differentiation in abstract-concrete. This lack of differentiation might be caused by the more uniform selective and normative pressures toward abstraction across all the university departments (Kolb & Goldman, 1973; Kolb, 1984). The results of the Kolb and Goldman (1973) study clustering academic majors by learning styles were that Management ($n = 20$), Chemical engineering ($n=13$), Chemistry ($n=14$), Mechanical Engineering ($n=10$), and Electrical Engineering were accommodators; Architecture ($n=15$), Humanities ($n=11$), Biology ($n=46$), and Earth Science ($n=14$) were divergers; Mathematics ($n=27$) was assimilator; and Physics and Economics were convergers.

In distance education, there has been little research using the LSI that compares academic fields and learning styles. An exception was the study conducted by Pigg et al. (1980). The results of their study revealed that both Agriculture and Home Economics were in the Accommodative style. In the Hebrew

version of Kolb's LSI, Katz (1988) found that Social Work, History, and Education were accommodators, Psychology was diverger, and Mechanical Engineering, Mathematics, Biology, and Electrical Engineering were convergers.

Kolb's Learning Styles and Achievement

Theill (1984), Vondrell and Sweeney (1989), and Dille and Mezack (1991) used Kolb's LSI to relate learning styles to achievement in distance education. As described in the "Kolb's Learning Styles in Distance Education" section, Dille and Mezack used the LSI scores in addition to the type of learning styles. They found that successful students scored lower on CE and higher on AC-CE than did the non-successful students.

Kolb and Goldman (1973) and Kolb (1981 and 1984) divided the students of four academic fields into students whose learning styles matched their academic fields and students whose learning styles did not match their academic fields. They found significantly higher GPAs for students whose learning styles matched their academic fields than those for students whose learning styles did not match their academic fields in two of the four academic fields.

Other studies related the LSI scores and achievement. That higher achievement related to higher scores on AC was found by

Kevin and Liberty (1973, an organic chemistry course using computer-based instruction); Thompson (1979, university students); Titus, Bergandi, and Shryok (1990, senior high school students), and Hudak and Anderson (1990, introductory statistics and computer science courses). Students receiving debriefing activities in the abstract conceptualization stage attained higher achievement than those students receiving debriefing in the other stages (Wighton, 1991, elementary-school students). Higher scores on the other LSI scores that were found related to higher achievement were AC-CE (Thompson, 1979; and Titus et al, 1990), and AE and AE-RO (Titus et al., 1990).

Summary of the Literature

An examination of the literature on learning styles reveals an interesting evolution in the construct. From the general and traditional theories of learning, Kolb generated an eclectic concept, experiential learning, and a matching instrument, the LSI. Although definitions of learning styles and the instrumentation are varied, Kolb's ideas and instrument dominate. The LSI appears reliable and valid, and it has been used in many traditional and some non-traditional settings. As well, the LSI is related to academic fields of study, predicts student success, and applies cross-culturally.

CHAPTER 3: RATIONALE, DEFINITIONS, AND RESEARCH QUESTIONS

Rationale

Bloom (1976) proposed a theory of school learning; it was an attempt to outline a small number of factors which could account for much of the variation in school learning. In his theory, there are three important elements: student characteristics, instruction, and learning outcomes. The student characteristic elements are cognitive entry behaviour and affective entry behaviour. The instruction element is the quality of the

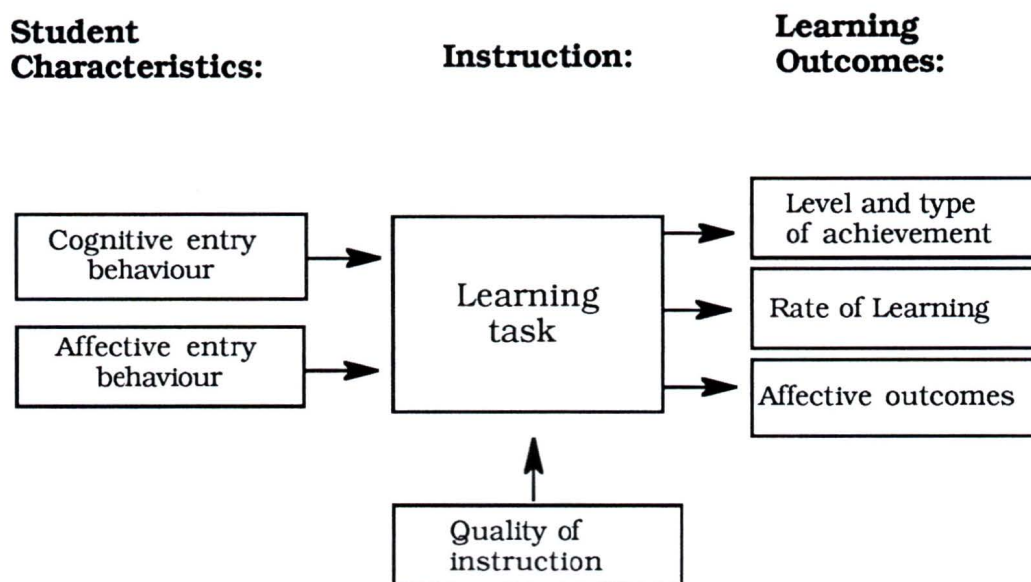


Figure 1. Bloom's variables in the theory of school learning
(Bloom, 1976, p. 11)

instruction. Cognitive entry behaviour, affective entry behaviour, and the quality of instruction are interdependent variables that account for the greatest degree of variance in student learning (see Figure 1).

Bloom hypothesized that, when cognitive entry behaviour, affective entry behaviour, and quality of instruction are favourable, all the learning outcomes will be at a high or positive level and that there should be little variation in the measure of outcomes. He stated that "characteristics of the learners as well as the characteristics of instruction can be modified in order to effect a higher level of learning for individuals and groups" (p. 14). For this study, the model was modified to investigate learning styles and academic achievement in distance education (Universitas Terbuka). The learning style was based

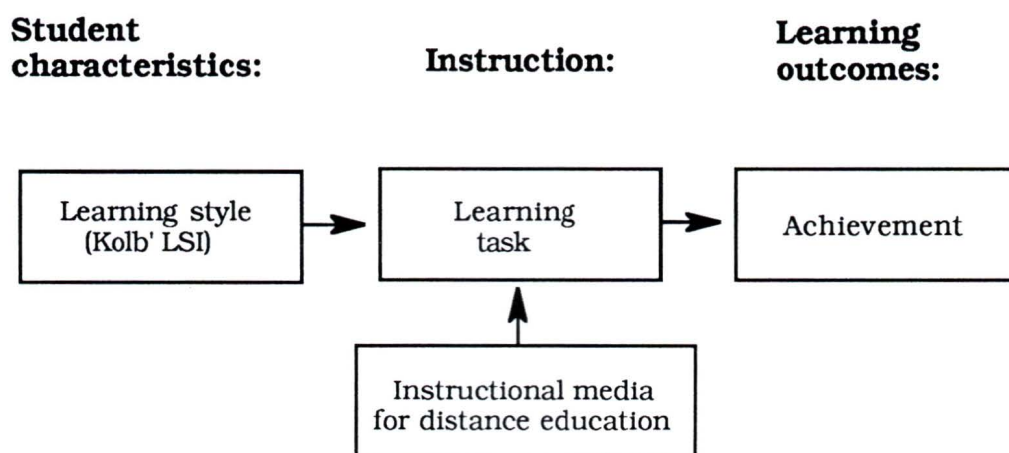


Figure 2. Bloom's variables in the theory of school learning modified for this study.

on Kolb's views. The modified model is shown in Figure 2.

The LSI has the appropriate characteristics, such as those described by Borg and Gall (1989) of objectivity, condition of administration, normative data, validity, and reliability, to be used as a standardized instrument in educational research. Karrer (1988) elaborated the strengths of the instrument in terms of its simplicity as a self-report test and its normative data tested in a large sample with diverse backgrounds. The instrument is also appropriate for this study since it was developed for college or university students. As well, Kolb's LSI is one of the most frequently cited learning style instruments used in research examining adult learners (Rule & Grippin, 1988).

It should be recalled that learning style is not a fixed trait (Kolb, 1984). Riding and Cheema (1991) viewed learning style as a process, and they focused both on how the style changes and, at the same time, how the learning environment may foster the change and reduce the weaknesses. Kolb's LSI was designed to measure this process ---an individual's strengths and weaknesses as a learner (Kolb, 1985). Although the individual teacher or professor may be aware of the learning process and individual differences in learning, universities, whether conventional or distance, do not formally recognize learning

styles when constructing either programs or learning materials. Universitas Terbuka, for example, does not provide different study materials to accommodate different types of students. In fact, over 90% of the instructional media is printed materials. This is important to consider because Kolb (1984) suggested that learning environments implicitly produce degrees of orientation toward the four learning modes of his model (concrete experience, reflective observation, abstract conceptualization, and active experimentation).

In summary, the basis or rationale for this study is found in the convergence of three areas. Bloom proposes that school learning is an interaction between the students, the instruction, and the outcomes. A critical student characteristic is apparently the student's learning style. Instruction, in this case, is moderated by the environment created by the distance education institution. Outcome is, in most instances, the achievement of the students. It makes imminent sense, therefore, both to investigate the learning styles of students in a distance institution which employs a limited instructional medium and to predict achievement on the basis of learning style.

It is also expected that generating information on students' learning styles will be useful for improving students learning or

achievement either by providing orientations that address the students' weaknesses or by providing learning environments that are sensitive to the average learning styles of students.

Definitions

Learning Style

The definition of learning style used in this study was Kolb's learning style, which is based on **a four-stage cycle of learning**: concrete experience (**CE**); reflective observation (**RO**); abstract conceptualization (**AC**); and active experimentation (**AE**). The LSI measures the students' relative emphasis on each of these four learning stages (CE, RO, AC, and AE = **learning orientations = learning modes**). The results are the four **basic scores**. The instrument also measures the extent to which the students emphasize abstractness over concreteness (**AC-CE**), the extent to which the students emphasize action over reflection (**AE-RO**), or the extent to which the students **resolve the opposing tensions** both between AC and CE and between AE and RO. The results are the **composite scores** or **combination scores**. The scores on AC-CE and AE-RO are the coordinate points on the normative data (LSI norm) indicating the **types of learning styles**: **accommodator, diverger, assimilator, and converger** (Kolb,

1984, Kolb, 1985, and Smith & Kolb, 1986).

Normative and Ipsative Comparison

Normative comparison in this study consisted of comparing each of the four basic scores and the composite scores **between faculties**. **Ipsative** comparison consisted of comparing the four basic scores **within each faculty** and **within the total sample** (modified from Kolb, 1984).

Achievement

The criterion for achievement used in this study was the grade point average (**GPA**) of students at Universitas Terbuka. The GPA is the total number of grade points earned divided by the total number of units of credit taken on a four-point system. Four points are awarded for an A, three points for a B, two points for a C, one point for a D, and zero for a failing grade of E.

Research Questions

This study is primarily concerned with investigating students' learning styles at Universitas Terbuka using an instrument, the LSI, which has three components: 1) Basic scores (scores on CE, RO, AC, and AE = learning modes =

learning orientations); 2) Composite scores (AC-CE = abstract-concrete = opposing tensions between abstract and concrete, and AE-RO = active-reflective = opposing tensions between active and reflective); and 3) type of learning styles (the categorical data: accommodator, diverger, assimilator, and converger). The research questions are related to these three components, the four faculties, and the students' GPA.

Research Question #1

Do students of different faculties (represented by one study program for each faculty) perform differently in emphasizing the four learning orientations measured? Which of these learning orientations is significantly different among faculties? Between which faculties are there differences?

Research Question #2

Do students within each faculty perform differently in emphasizing the four learning orientations? Between which of the learning orientations are there differences?

Research Question #3

Do students of Universitas Terbuka (within the total sample) perform differently in emphasizing the four learning orientations? Between which of the learning orientations are there differences?

Research Question #4

Do students of different faculties perform differently in resolving the opposing tensions between the abstract and concrete

orientations (AC-CE), and between the active and reflective orientations (AE-RO) of Kolb's Experiential Learning Model? Which of these two dimensions is significantly different among faculties?

Research Question #5

Is the distribution of performance on the LSI (learning styles) dependent on faculties?

Research Question #6

Do students of different faculties and different learning styles achieve different GPAs?

Research Question #7

Do students of different learning styles within each faculty obtain different GPAs? Which group of students (based on their learning styles) gain the highest GPAs within each faculty?

CHAPTER 4: METHOD

Overview

The standardized instrument used in this study was the Learning-style Inventory (LSI). It was translated from English into Indonesian, and the respondents were students of the four faculties at Universitas Terbuka (Indonesian Open Learning University). The data was collected in Indonesia from June, 1992 (sending the questionnaires) through July, 1992 (receiving the last questionnaires).

The independent variable was faculty (4 levels), and the dependent variables were the four basic scores and the two composite scores of the instrument. As a result of the students' responses, learning styles (4 levels) became the second independent variable. For learning outcomes, GPA was also used as a dependent variable.

The calculation of the students' responses on the instrument was based on the instrument manual. Statistical analyses (SPSS Program) used in this study were Manova, Anova, Multiple Comparison (LSD), *t* test, and Chi-square.

Instrumentation

The Instrument

The Kolb's Learning-Style Inventory is a 12-item instrument. Each of the 12 items contains a main sentence and 4 endings indicating the four learning modes or orientations of the Kolb's experiential learning model (4-stage cycle): concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). The instrument measured the respondents' relative emphasis on each of the four learning modes by ranking the four sentence endings of each item from 1 to 4. Their relative emphases are their total scores of the 12 items on each of the four sentence endings. There are 2 composite scores that indicate the extent to which the respondents preferred abstractness over concreteness (AC minus CE) and the extent to which the respondents preferred action over reflection (AE minus RO). The AC-CE and AE-RO are the two bipolar dimensions. The four quadrants of these two bipolar dimensions include the four types of learning: accommodator, diverger, assimilator, and converger (see Figure 3).

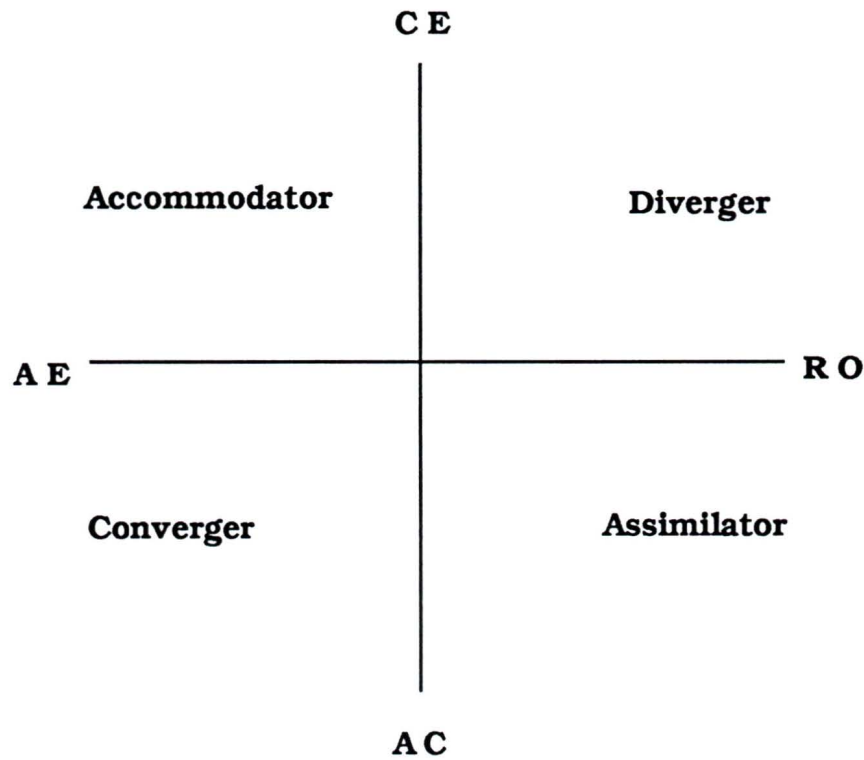


Figure 3. Kolb's Learning Styles (adapted from Kolb, 1985).

Translation and Pilot Information

The researcher translated the instrument from English into Indonesian. Eleven staff members of Universitas Terbuka enrolled in a graduate program at the University of Victoria evaluated the clarity of each sentence in the Indonesian version and the appropriateness of the translation using 5 points (1 = not clear/not appropriate and 5 = clear/appropriate) which were based on their own understanding in English and Indonesian. They mostly ranked the translation 4. However, their comments

were considered more important. One important comment was that the translation of "like to" (When I learn, I like to ...), which was translated by the researcher to be "ingin", should be translated as "lebih suka". In Indonesian, "ingin" also means "want to". One difficulty in translating this instrument was that there was no object after the verb "learn" in all of the 12 items. The author put "sesuatu" ("something") after the verb "learn". Moreover, the verb "learn" and "study" in Indonesian has the same term ("belajar").

The pilot continued on-site, in Indonesian, and twenty one students of Universitas Terbuka who were taking intensive tutorials at the Central Office in Jakarta also contributed to the Indonesian version of the instrument. They responded on the clarity of the main sentences and the four endings by ranking the level of clarity from 1 (not clear) to 4 (clear). The mean of their responses on each of the 12 main sentences was higher than 3.5 (between moderately clear and clear). Nine of the forty eight sentence endings which were ranked less than 3.0 (moderately clear) were: 1-CE (sentence ending item #1 for concrete experience), 2-CE, 3-CE, 3-RO, 4-CE, 6-RO, 9-CE, 10-CE, and 10-RO. The researcher revised the instrument, asked 5 students to fill in the instrument, and discussed it with them. They found no difficulty in responding to the questionnaire.

Reliability and Validity of the Instrument

Kolb's LSI has been widely used, especially in North America. Rule and Grippin (1988) found that Kolb's LSI is one of the most frequently cited learning style instruments in research examining adult learning, and Sims et al. (1986) stated that Kolb's LSI has received considerable attention during the past ten years. Hunsaker (1981) reviewed the use of Kolb's LSI in predicting performance in education, predicting career choices, and application in management. As well, the instrument has been translated into several languages including French (Theill, 1984), German (Karrer, 1988), and Hebrew (Katz, 1988).

Moderate to high reliabilities (ranging from .55 to .88) were found by Marshall and Merritt (1985 and 1986), Merritt and Marshall (1984), Sims et al. (1986), and Smith and Kolb (1986). For this study, the internal reliability was estimated by Cronbach's alpha. The validity of the instrument was supported by results of the study conducted by Marshall and Merritt (1985 and 1986), Katz (1988), and Ferrell (1983). Factorial Analysis was used for the validity test (A two-factor solution with varimax rotation was run to examine the construct validity of Kolb's two bipolar dimensions.). Coefficient reliability and factor loadings are found in Appendix A and Appendix B respectively.

Respondents

The target population of this study was the students who had completed a significant component of a program (had taken more than 60 units of about 150 to 160 required units) from the Faculty of Economics (Management study program), Faculty of Mathematics and Natural Science (Applied-Statistics study program), Faculty of Social and Political Science (Developmental-Administration study program), and Faculty of Education (Mathematics-in-Education study program). One hundred students who completed at least 60 units were randomly selected from each faculty.

Data Collection

The instruments (395 questionnaires), including a letter from the Rector and an introduction to the instrument, were sent to the students by mail. They were sent in early June, 1992, and the last responses were received in the middle of July, 1992 (218 responses). The achievement data were grade point averages (GPA) were obtained from the UT computing centre. Contextual data collected on the questionnaires from the respondents included age, academic background, number of units, year of registration, and occupation.

Data Analysis

Scores on LSI and Learning Styles

Students' responses on the LSI were analyzed based on the Self-scoring Inventory and Interpretation Booklet (Kolb, 1985) and the User's Guide (Smith & Kolb, 1986). The data from this analysis included LSI basic scores (CE, RO, AC, and AE); LSI composite scores (AC-CE and AE-RO); and learning style category (accommodator, diverger, assimilator, and converger).

Test of Significant Differences between Faculties on LSI Scores

To test differences between faculties on the LSI, the four faculties acted as the independent variable, and the dependent variables included both basic scores (CE, RO, AC, and RO) and composite scores (AC-CE and AE-RO). Multivariate analysis of variance (Manova) was employed to test differences of the combined-dependent variable among faculties. Univariate analysis of the Manova was used to test differences of each dependent variable among faculties. Multiple comparison (Least Significant Difference or LSD) was employed to test the difference of each dependent variable between pairs of faculties.

Testing Significant Differences within each Faculty and within Total Sample on LSI Scores

To test differences within each faculty and the total sample,

the independent and dependent variables were the same as for testing differences between faculties. A within-subject Manova was used for testing differences among dependent variables within each faculty and within the total sample. Multiple comparison (LSD) tested differences between two dependent variables within each faculty and within the total sample.

Learning Styles

Plotting the LSI scores was accomplished by using the Kolb norms. The means of AC-CE and AE-RO of the LSI norm were 4.28 and 5.92 (Smith & Kolb, 1986) as the central point of the two bipolar dimensions (AC-CE and AE-RO) and of the four quadrants (Smith & Kolb, 1986). The students' scores on AC-CE and AE-RO were plotted on these quadrants. Testing distributions of learning styles involved both using the four faculties as the independent variables and the distribution as the dependent variable, and employing a 4x4 Chi square.

Learning Styles and Achievement

The relationship between Faculty, learning style, and achievement was analyzed by using a 4x4 Anova. The four faculties and the learning styles were the independent variables and the GPA (as the criterion for achievement) was the

dependent variable.

CHAPTER 5: RESULTS

Overview

The response rates were categorized by each faculty, total valid responses, non-valid responses, questionnaires returned by the Post Office, and Regional Offices.

Analyzing the LSI involves several steps. The LSI is a 12-item instrument. Each item contains 4 choices to be ranked indicating the respondents' relative emphasis on each of the four basic learning modes: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). Based on these four basic scores, there are two composite scores indicating the extent to which the students (respondents) emphasize abstractness over concreteness (AC-minus CE) and the extent to which they emphasize action over reflection (AE minus RO). The responses on the basic scores are used for analyzing the reliability (Cronbach's Alpha) and validity (Factor Analysis) of the instrument. The means of the basic and composite scores by faculties are also provided.

Abstract/concrete (AC-CE) and active/reflective (AE-RO) are two bipolar dimensions (AC-CE is the Y-axis and AE-RO is the X-axis). Students' scores on these two composite scores indicate

the coordinates, placing them on each of the four quadrants of the dimensions. These quadrants are the four types of learning styles: accommodator, diverger, assimilator, and converger. The distribution of these learning styles by faculties are displayed in Figure 4 and in Table 5. The faculties' learning styles are displayed in Figure 5.

The means of students' achievement (GPA) were grouped by their faculties and learning styles. The correlations of variables were between four basic scores (CE, RO, AC, and AE), composite scores (AC-CE and AE-RO), and achievement (GPA). Evaluation of assumptions was analyzed for testing significant differences of the four learning modes (the four basic scores; research questions #1, #2, and #3), the composite scores (research question #4), the learning style distribution (research question #5), and the students' achievement (research questions #6 and #7). Testing of significant differences of GPA between abstract students and concrete students, between active students and reflective students, and between education students and non-education students were also conducted.

Response Rate

There were 100 students randomly selected from each of the Faculty of Economics (Management study program), from the

Faculty of Mathematics and Natural Science (Applied-Statistics study program), and from the Faculty of Social and Political Science (Developmental-Administration study program). Since Education students already have a three-year diploma before enrollment, there were only 95 students from the Faculty of Education (Mathematics-in-Education study program) who had completed more than 60 units. In total, questionnaires were sent to 395 students (from 30 Regional Offices).

The completed responses to Kolb's LSI numbered 40 from the Faculty of Economics (40%), 46 from the Faculty of Mathematics and Natural Science (46%), 62 from the Faculty of Social and Political Science (62%), and 68 from the Faculty of Education (71.6%). Fourteen of the questionnaires were returned by the Post Office. The total of completed responses were from 28 Regional Offices (see Table 1).

Reliability and Validity of the Instrument

The internal reliability measured by Cronbach's Alpha (12 items, 4 responses for each item, $n = 216$) was between .689 (reflective observation) and .795 (active experimentation). The coefficient alpha of the the LSI found in this study and the coefficient alpha of the normative data are in Table 2. The complete results are presented in Appendix A.

Table 1
Responses to Kolb's Learning-Style Inventory (Questionnaire)

	Number of Questionnaires		
	Sent	Received	%
-Faculty of Economics	100	40	40.0%
-Faculty of Mathematics and Natural Sciences	100	46	46.0%
-Faculty of Politics and Social Sciences	100	62	62.0%
-Faculty of Education	95	68	71.6%
-Total valid responses	395	216	54.7%
-Returned by Post Office		14	3.5%
-Non valid responses		2	
-Number of Regional Offices	30	28	

Table 2.
Coefficient Alpha of Kolb's LSI

LSI Scores	UT Data (n=216)	Normative Data* (n=1,446)
C E	.734	.820
R O	.698	.730
A C	.725	.830
A E	.795	.780
AC-CE	.763	.880
AE-RO	.789	.810

* Smith and Kolb (1986)

A two factor solution, with varimax rotation, was run to examine the construct validity of Kolb's two bipolar dimensions. The factor loadings can be seen in Appendix B. Factor analysis

using the raw scores of the 48 responses of the 12 items with factor loadings not less than 3.00 clustered RO (8 items of the 12 items have factor loadings greater than 3.00, the lowest factor loading was .433) and AE (11 items, the lowest factor loading was -.366) in one factor. In the other factor were CE (9 items, -.360) and AC (9 items, .304). A factor loading greater than 3 was considered salient (Ferrell, 1983).

Basic Scores (Scores on CE, RO, AC, and AE)

Higher scores on a basic score indicated greater relative emphasis on a particular learning orientation (mode). The possible scores ranged between 12 and 48. The mean scores were ranging from 24.93 to 29.77 (CE), 28.59 to 30.78 (RO), 30.65 to 34.85 (AC), and 29.39 to 33.29 (AE). Means and standard deviations of the four basic scores of the respondents by their faculties are displayed in Table 3.

Composite Scores (Scores on AC-CE and AE-RO)

Higher positive score on a composite score indicated a more abstract (AC-CE) or a more active (AE-RO) emphasis. The possible scores for the composite scores were between -36 and 36. The range of the mean scores by faculties were between .87 and 9.74 (AC-CE), and between -1.71 and 4.71 (AE-RO) (see

Table 4).

Table 3
Means and Standard Deviations (SD) of the LSI's Basic Scores
(Scores on CE, RO, AC, and AE) With Different Faculties

		F a c u l t i e s :				
Basic Scores:		Economics	Math.&Nat.	Soc.&Pol.	Education	Total
C E	Mean	26.28	24.93	29.77	25.59	26.78
	S D	6.14	6.50	6.14	6.16	6.48
R O	Mean	29.23	30.78	30.19	28.59	29.63
	S D	5.55	6.49	5.18	6.59	6.03
A C	Mean	34.85	34.67	30.65	32.54	32.88
	S D	5.49	5.81	5.92	5.71	5.96
A E	Mean	29.65	29.61	29.39	33.29	30.71
	S D	7.14	5.68	7.58	6.82	7.06

Table 4
Means and Standard Deviations (SD) of the LSI's Composite
Scores (Abstract-Concrete = AC-CE and Active-Reflective =
AE-RO) With Different Faculties

		F a c u l t i e s :				
Composite Scores:		Economics	Math.&Nat.	Soc.&Pol.	Education	Total
AC-CE	Mean	8.58	9.74	0.87	6.96	6.10
	S D	9.79	10.97	10.52	10.58	11.00
AE-RO	Mean	0.43	-1.17	-0.81	4.71	1.08
	S D	11.09	10.84	11.56	12.28	11.75

Distribution of Learning Styles

The norm of the Kolb's LSI was developed from a sample of 1,446 adults between the ages of 18 and 60. The sample was ethnically diverse, with a wide range of career fields, and most respondents had completed at least two years of college education (Smith & Kolb, 1986). The coordinates of this norm on which the two dimensions (AC-CE as the Y-axis and AE-RO as the X-axis) crossed each other were 5.92 and 4.29 (average scores of the normative sample).

The respondents' composite scores (AC-CE and AE-RO) were the coordinates indicating their places in each of the four quadrants of the LSI norm. The four quadrants were the four learning styles. The distributions of learning styles at Universitas Terbuka found in this study are displayed in Figure 4 and in Table 5.

Faculties' Learning Styles

The average of the abstract/concrete (AC-CE) scores and the active/reflective scores (AE-RO) of respondents from each faculty (see Table 4) were plotted on the LSI norm. The results revealed that students from the Faculty of Economics (Management study program), the Faculty of Mathematics and Natural Science (Applied-Statistics study program), and the

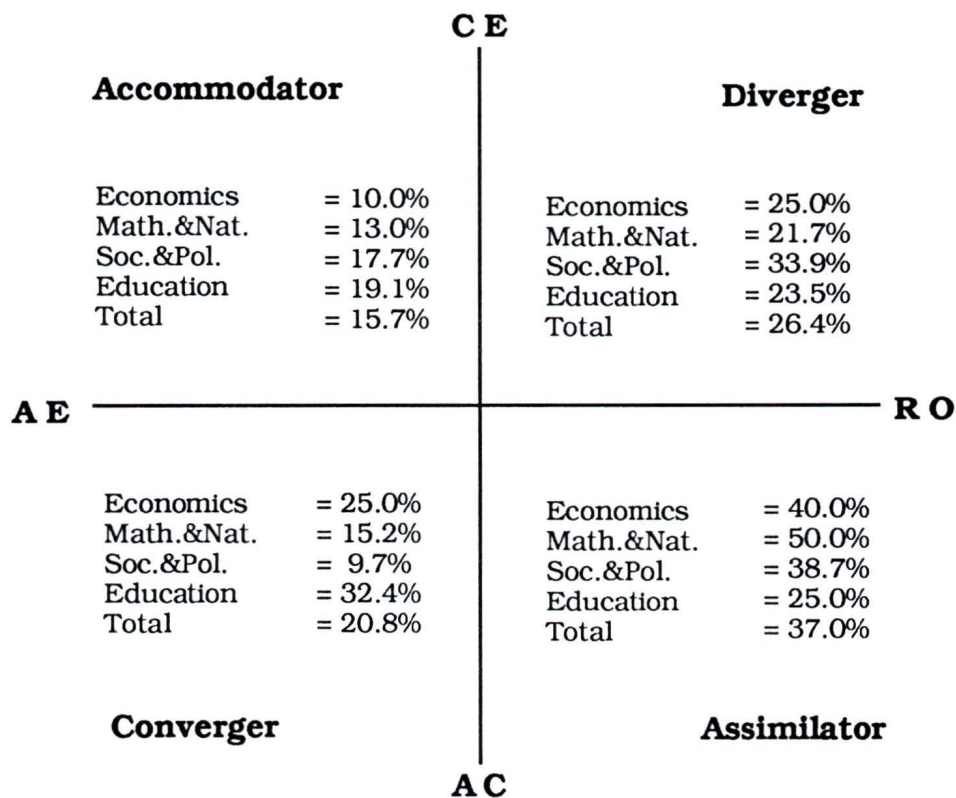


Figure 4. Distribution of learning styles

Table 5
Numbers and Percentages (in brackets) of Learning Styles
With Different Faculties

Learning Styles:	F a c u l t i e s :				Total
	Economics (n = 40)	Math.&Nat. (n = 46)	Pol.&Soc. (n = 62)	Education (n = 68)	
Accom.	4(10.0)	6(13.0)	11(17.7)	13(19.1)	34(15.7)
Assim.	16(40.0)	23(50.0)	24(38.7)	17(25.0)	80(37.0)
Conver.	10(25.0)	7(15.2)	6(9.7)	22(32.4)	45(20.8)
Diverg.	10(25.0)	10(21.7)	21(33.9)	16(23.5)	57(26.4)

Faculty of Education (Mathematics-in-Education study program) tended to be assimilators; and students from the Faculty of Social and Political Science (Developmental-Administration study program) tended to be divergers (see Figure 5).

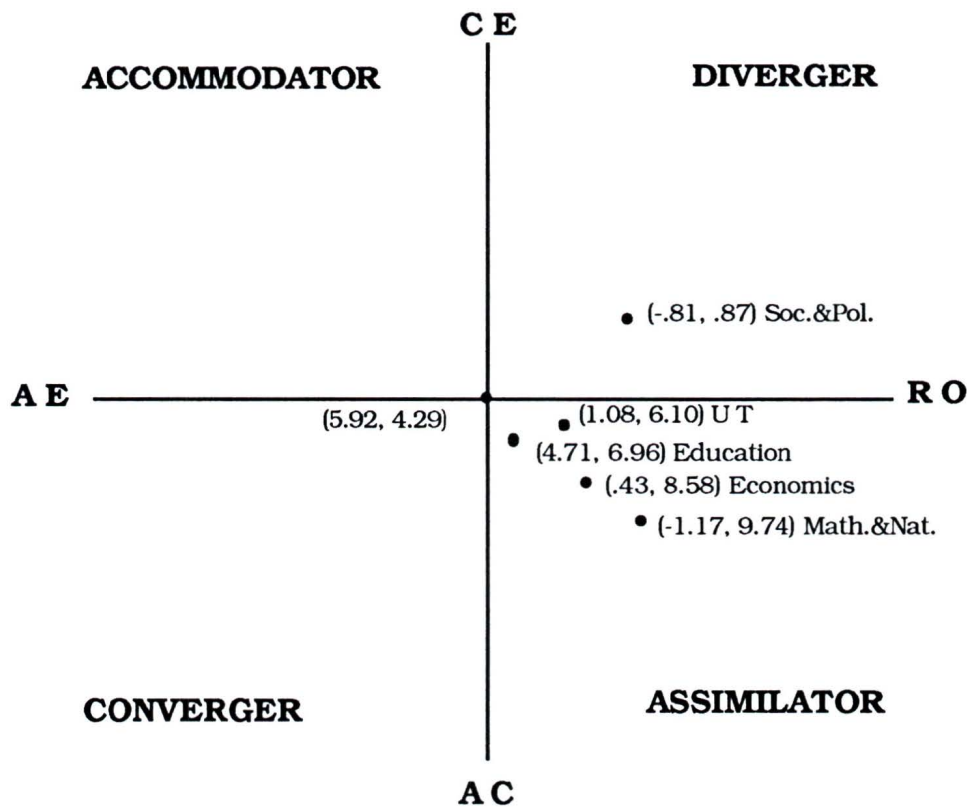


Figure 5. Average composite scores (AE-RO and AC-CE) for each faculty and their places in the learning-style quadrants.

Student Achievement (Grade Point Average)

The GPA scale applied at Universitas Terbuka is from 0 to 4. The final grades for each course are A (very good = 4), B (good = 3), C (average = 2), D (below average = 1), and E (fail = 0). The

GPA is the total of the multiplication of the final grade and unit of each course divided by the total number of course units taken by the student. The means and standard deviations of GPA by faculty and learning style are shown in Table 6.

Table 6
Means and Standard Deviations (in bracket) of GPA With Different Faculties and Learning Styles

F a c u l t i e s :					
Learning Styles:	Economics	Math.&Nat.	Soc.&Pol.	Education	Total
Accom.	1.26(.55)	1.41(.35)	1.30(.43)	1.63(.28)	1.44(.39)
Assim.	1.59(.35)	1.57(.44)	1.57(.36)	1.70(.32)	1.60(.38)
Conver.	1.70(.52)	1.61(.43)	1.69(.43)	1.68(.35)	1.67(.40)
Diverg.	1.61(.31)	1.34(.43)	1.66(.43)	1.69(.31)	1.60(.39)
Total	1.59(.41)	1.50(.43)	1.56(.41)	1.68(.32)	1.59(.39)

Correlations among LSI Scores and GPA

The correlations among the six dependent variables (CE, RO, AC, AE, AC-CE, and AE-RO) are shown in Table 7. They ranged from .017 to .914. Moderately high negative and significant correlations were found between both AC and AE, and between AE and RO. There was a very low and non-significant correlation between the two composite scores. Correlations between these

six LSI scores and GPA also appear in Table 7. There were very low but significant correlations between GPA and AC (.132) and AC-CE (.127).

Table 7
Correlation between Variables

	R O	A C	A E	AC-CE	AE-RO	GPA
C E	-.198**	-.563**	-.274**	-.894**	-.064	-.095
R O	x	-.072	-.611**	.078	-.880**	-.057
A C	x	x	-.267**	.874**	-.124*	.132*
A E	x	x	x	.017	.914**	.027
AC-CE	x	x	x	x	-.030	.127*
AE-RO	x	x	x	x	x	.046

** $p < .001$ * $p < .05$

Evaluation of Assumptions for Analyses

Two of the 218 cases were deleted because the students did not respond in accordance with the instructions. There was no missing datum on any of the dependent variables of the remaining 216 cases. According to Tabachnick and Fidell (1989), in using Manova, it is necessary to have more cases than dependent variables in every cell. For testing differences in LSI scores between faculties, the 216 students were in four groups of faculties (cells). The smallest group consisted of 40 students. This sample size was 10 times the number of dependent

variables. For testing the differences in GPA by faculty and learning style (4x4 groups), the sample sizes were between 4 and 24. This was 4 times as many cases as the number of dependent variables (GPA) in the smallest group.

Using Liliefors test of normality, one of the 7 dependent variables was not normal in one cell (variable CE in the Faculty of Social and Political Science). However, according to Tabachnick and Fidell (1989), a sample size of about 20 in the smallest cell ensured multivariate normality as it is related to degrees of freedom for error. Skewness and kurtosis were not extreme. There were no extreme scores which were higher or lower by more than 3 times the standard deviation from the mean. Homogeneity of variance using Cochran's C between groups for each of the dependent variables appeared to be present.

Differences in Learning Orientations (Scores on CE, RO, AC, and AE)

Research Question #1:

Do students of different faculties (represented by one study program for each faculty) perform differently in emphasizing the four learning orientations measured by the LSI? Which of these learning orientations is significantly different between faculties? Between what faculties are there differences?

Table 3 displays the means and standard deviations of the basic scores (learning orientations). Using a Multivariate

Analysis of Variance (Manova), the differences across faculties in the four basic scores as a combined variable was significant, $F(12, 553)$, $p < .000$ (see Table 8).

Table 8
Multivariate Analysis of Variance of CE, RO, AC, and AE as A Combined Dependent Variable by Faculty

Wilks' Lambda	Hyphot. df	Error df	Multivariate F	p
.83	12	553.25	3.30	.000

The Univariate F -test of Manova did not indicate significant differences in RO as a single dependent variable across faculties. The other three variables were significant as illustrated in Table 9.

Table 9
Univariate Analysis of Variance of CE, RO, AC, and AE as Individual Dependent Variables by Faculty

Variables	S S	df	M S	F	p
C E	819.24	3	273.08	7.05	.000
R O	161.16	3	52.72	1.49	.218
A C	620.60	3	206.87	6.25	.000
A E	663.32	3	221.11	4.66	.004

A Multiple Comparison (Least Significant Different = LSD) was conducted for each of the significant variables in Table 9 (CE, AC, and AE). Significant differences were found between the Faculty of Social and Political Science and the other three faculties in CE and in AC (except Education), and between the Faculty of Education and the other three faculties in AE. Education was also significantly different from Economics in AC. Pairs of faculties in which each of the three variables were significant are shown in Table 10.

Table 10
Pairs of Faculties in which the Differences of CE, AC, and AE were Significant (Multiple Comparison LSD, $p < .05$)

Variables	Pairs of Faculties
C E	Soc.&Pol. & Economics Soc.&Pol. & Math.&Nat. Soc.&Pol. & Education
R O	-
A C	Soc.&Pol. & Economics Soc.&Pol. & Math.&Nat. Education & Economics
A E	Education & Economics Education & Math.&Nat. Education & Soc.&Pol.

Research Question #2:

Do students within each faculty perform differently in emphasizing the four learning orientations? Between which of the learning orientations are there differences?

A within-subject Manova was conducted for each faculty for analyzing differences in the four learning orientations within each faculty. There was no significant difference found among CE, RO, AC, and AE within the Faculty of Social and Political Science. The differences within the other three faculties were significant. The p value for each faculty is shown in Table 11.

Table 11
Test of Differences of the Four Learning Orientation (CE, RO, AC, and AE) within each Faculty

Faculty	<i>S S</i>	<i>df</i>	<i>M S</i>	<i>F</i>	<i>p</i>
Economics	1524.85	3	508.28	9.82	.000
Math.&Nat.	2220.30	3	740.10	14.30	.000
Soc.&Pol.	54.58	3	18.19	0.35	.788
Education	2637.07	3	879.02	16.98	.000

The results of a Multiple Comparison (LSD) between learning orientations within each faculty are displayed in Table 12. There was no significant difference found between any pair of the LSI scores within Social and Political Science. Between RO and AE, the significant difference was only within Education. Within Economics and Mathematics and Natural Science, only the

difference between RO and AE was not significant.

Table 12
Pairs of Learning Orientations in which the Differences within each Faculty were Significant (Multiple Comparison LSD, $p < .05$)

Faculties	Pairs of Variables					
	CE&RO	CE&AC	CE&AE	RO&AC	RO&AE	AC&AE
Economics	*	*	*	*	-	*
Math.&Nat.	*	*	*	*	-	*
Soc.&Pol.	-	-	-	-	-	-
Education	*	*	*	*	*	-

* significant - not significant

Research Question #3:

Do students of Universitas Terbuka (total sample) perform differently in emphasizing the four learning orientations? Between which of the learning orientations are there differences?

A Within-subject Manova was conducted to analyze the differences in the four learning orientations within the total sample (Universitas Terbuka). The results, which are shown in Table 13, were significant ($p < .000$). Students within the total sample were significantly different in emphasizing CE, RO, AC, and AE.

Table 13
Test of Differences of Four Learning Orientations within the Total Sample

Source	S S	df	M S	F	p
Main Effect	4172.48	3	1390.83	25.49	.000
Error	35191.77	645	54.56		

The results of the Multiple Comparison are displayed in Table 14. The differences were significant between two of the four learning orientations, except between RO and AE.

Table 14
Pairs of Learning Orientations in which the Differences within the Total Sample were Significant (Multiple Comparison LSD, $p < .05$)

Pairs of Variables:	CE&RO	CE&AC	CE&AE	RO&AC	RO&AE	AC&AE
Significance :	*	*	*	*	-	*

* significant - not significant

Differences in Abstract/Concrete and Active/Reflective (Scores on AC-CE and AE-RO)

Research Question #4:

Do students of different faculties perform differently in resolving the opposing tension between abstract and concrete, and between active and reflective of the LSI? Which of these two dimensions is significantly different among faculties?

The results of the Manova for testing differences of abstract/concrete and active/reflective revealed that these two variables between faculties were significantly different as a combined variable, $F(6, 422) = 5.62, p < .000$ (see Table 15).

Table 15
Multivariate Analysis of Variance of AC-CE and AE-RO as A Combined Dependent Variable across Faculties

Wilks' Lambda	Hyphot. <i>df</i>	Error <i>df</i>	Multivariate <i>F</i>	<i>p</i>
.86	6	422	5.62	.000

As a single variable (Univariate test), the differences in both abstract/concrete and active/reflective between faculties were significant. The summary of the Univariate *F*-test is in Table 16.

Table 16
Univariate Analysis of Variance of AC-CE and AE-RO as Individual Dependent Variables across Faculties

Variables	S S	<i>df</i>	M S	<i>F</i>	<i>p</i>
AC-CE	2599.28	3	866.43	7.85	.000
AE-RO	1365.48	3	455.16	3.40	.019

The results of a Multiple Comparison indicated that the significant differences in abstract/concrete were between the Faculty of Social and Political Science and the other three faculties. The significant differences in active/reflective were between the Faculty of Education and two other faculties (Economics and Mathematics and Natural Science) as shown in Table 17.

Table 17
Pairs of Faculties in which the Differences of AC-CE and AE-RO were Significant (Multiple Comparison LSD, $p < .05$)

Variables	Pairs of Faculties
AC-CE	Soc.&Pol. & Economics Soc.&Pol. & Math.&Nat. Soc.&Pol. & Education
AE-RO	Education & Math.&Nat. Education & Soc.&Pol.

As is mentioned in the evaluation of assumptions, distribution of CE was not normal in one cell. Using a nonparametric test (Kruskal-Wallis one-way Anova), the same results were found for significant differences of the six dependent variables across faculties. According to Borg and Gall (1989), if the two tests (parametric and nonparametric) yield different results, it is the

nonparametric test which should be reported.

Distribution of Learning Styles across Faculties

Research Question #5:

Is the distribution of performance on the LSI (learning styles) dependent on different faculties?

A 4x4 Chi-Square test for distribution of the four learning styles across faculties was conducted. Table 5 provides the distribution of learning styles. The distribution of the learning styles was dependent on faculties and was statistically significant, $X\text{-square}(9) = 17.59, p < .04$

Students' Achievement (GPA) and Learning Styles

Research Question #6:

Do students of different faculties and different learning styles achieve different GPAs?

Research Question #7:

Do students of different learning styles within each faculty gain different GPAs? Which group of students (based on their learning styles) obtain the highest GPAs within each faculty?

Differences of means of GPAs across faculties, across learning styles, and interaction between faculties and learning styles analyzed by 2x4 Anova were not significant. Because the results of Anova did not indicate any significant difference, a simple

effect test to find significant differences of GPA between styles within each faculty was not conducted. The means of GPA by faculty and learning style are in Table 6 and the summary of the Anova is in Table 18.

Table 18
Analysis of Variance of GPA across Faculties and Learning Styles

Source	<i>df</i>	<i>S S</i>	<i>M S</i>	<i>F</i>	<i>p</i>
Faculty	3	0.86	0.29	1.92	.128
Style	3	1.10	0.37	2.45	.065
Interaction	9	1.06	0.12	0.79	.629
Error	200	29.87	0.15		

Total	215	32.89			

Achievement (GPA) between Abstract and Concrete Students and between Active and Reflective Students

Correlations between LSI scores and GPA indicated very low but significant correlations between GPA and AC and AC-CE. A test of significant differences (*t*-test) of GPA was conducted between a group of students whose scores on AC-CE were higher than the total sample mean (abstract students) and another group of students whose scores on AC-CE were lower than the total sample mean (concrete students). The analysis was also conducted on the other dimension (scores on AE-RO, between

active students and reflective students).

The results of *t*-test of GPA between abstract students and concrete students indicated significant differences of GPA ($p < .05$) in the total sample and in the Faculty of Mathematics and Natural Science (Table 19). Abstract students gained higher GPAs. Between active students and reflective students, the significant difference was found in the Faculty of Social and Political Science (Table 20). Reflective students achieved higher GPAs.

Table 19
Differences of GPA between Abstract Students and Concrete Students

Faculties	Abstract/ Concrete	<i>n</i>	Mean of GPA	<i>SD</i>	<i>t</i>	<i>p</i>																																									
Economics	Abstract	24	1.63	.44	0.78	.441																																									
	Concrete	16	1.53	.38			Math.&Nat.	Abstract	27	1.61	.43	2.11	.041	Concrete	19	1.35	.38	Soc.&Pol.	Abstract	25	1.66	.34	1.51	.136	Concrete	37	1.50	.45	Education	Abstract	33	1.71	.31	.87	.389	Concrete	35	1.64	.32	Total	Abstract	109	1.66	.38	2.52	.013	Concrete
Math.&Nat.	Abstract	27	1.61	.43	2.11	.041																																									
	Concrete	19	1.35	.38			Soc.&Pol.	Abstract	25	1.66	.34	1.51	.136	Concrete	37	1.50	.45	Education	Abstract	33	1.71	.31	.87	.389	Concrete	35	1.64	.32	Total	Abstract	109	1.66	.38	2.52	.013	Concrete	107	1.52	.40								
Soc.&Pol.	Abstract	25	1.66	.34	1.51	.136																																									
	Concrete	37	1.50	.45			Education	Abstract	33	1.71	.31	.87	.389	Concrete	35	1.64	.32	Total	Abstract	109	1.66	.38	2.52	.013	Concrete	107	1.52	.40																			
Education	Abstract	33	1.71	.31	.87	.389																																									
	Concrete	35	1.64	.32			Total	Abstract	109	1.66	.38	2.52	.013	Concrete	107	1.52	.40																														
Total	Abstract	109	1.66	.38	2.52	.013																																									
	Concrete	107	1.52	.40																																											

Table 20
Differences of GPA between Active Students and Reflective Students

Faculties	Active Reflective	<i>n</i>	Mean of GPA	<i>SD</i>	<i>t</i>	<i>p</i>
Economics	Active	20	1.66	.50	1.16	.252
	Reflective	20	1.51	.30		
Math.&Nat.	Active	17	1.48	.41	-.28	.784
	Reflective	29	1.51	.45		
Soc.&Pol.	Active	26	1.41	.41	-2.48	.016
	Reflective	36	1.67	.39		
Education	Active	43	1.69	.30	.40	.693
	Reflective	25	1.66	.34		
Total	Active	106	1.58	.40	-.28	.781
	Reflective	110	1.60	.38		

Achievement between Education Students and Non-Education Students

The frequencies of learning styles indicated that the dominant style of respondents from the Faculty of Education was converger, and the dominant style from the other faculties was assimilator. An additional test of differences of GPA (as dependent variable) was conducted (2x4 Anova). The first independent variable was faculty (Faculty of Education in one group and the other three faculties in another group). The independent variables were the four learning styles. The differences of GPA between the two groups of faculties were significant, $F(1,208) = 4.71$, $p < .031$, but the differences across

styles were not significant, $F(3,208) = 2.47$, $p < .063$. That is, the GPA of the education students was higher than the GPA of the other students. A non significant difference was also found for the interactions, $F(3,208) = .96$, $p < .415$ (see Table 21).

Table 21
Analysis of Variance of GPA between Group of Faculties
(Education and Non Education) across Learning Styles

Source	<i>df</i>	<i>S S</i>	<i>M S</i>	<i>F</i>	<i>p</i>
Group	1	.70	.70	4.71	.031
Style	3	1.09	.37	2.47	.063
Interaction	3	0.42	.14	.96	.415
Error	208	30.67	.15		
Total	215	32.88			

Contextual Data

Some demographic data related to this research were collected. The data included age, year of registration, number of units completed, the relationship between educational background (kind of high school) and the study program, and the relationship between students' occupation and their study programs. These data are illustrated in Appendix C.

CHAPTER 6: DISCUSSION AND CONCLUSIONS

Discussion

Overview

The results of the study for the most part followed the predictions of Kolb's experiential learning theory. The results indicated moderately high negative, relationships between AC and CE, and between AE and RO. There was a very low, non-significant relationship between AC-CE and AE-RO. According to Kolb (1984), AC and CE, and AE and RO are opposed, and AC-CE and AE-RO are statistically independent. The results of Factor Analysis relatively supported Kolb's views (see Appendix B).

Taking the data further involves considering the LSI as both a normative and an ipsative test. The normative test allows comparison between individuals in their relative emphasis on a given learning orientation. The ipsative test allows comparison within individuals in their relative emphasis on the four learning orientations. In this study, the normative test involved a comparison between faculties (represented by one study program for each faculty) in their relative emphasis on each of the four learning orientations and the composite scores. The

ipsative test was the comparison between the four learning orientations within each faculty. It was also the comparison between the learning orientations within Universitas Terbuka (the total sample).

The normative comparison was related to research questions 1 and 4, and the ipsative comparison was related to research questions 2 and 3. Research question number 5 is discussed in the 'Learning Styles' section, and research questions 6 and 7 are in the 'Students' Achievement and Learning Styles' section of this chapter. Students' achievement between abstract students and concrete students, between active students and reflective students, and between education students and non-education students are also given. An overall interpretation of the results and their relationship both to Kolb's learning styles and to the educational system at Universitas Terbuka is presented at the end of this chapter.

Normative Comparison of LSI Scores (Research Questions #1 and #4)

Research question number 1 focussed on the differences in the learning orientations or basic score between faculties, and research question number 4 centered on the differences in the composite scores between faculties.

The four faculties were significantly different on emphasizing

the four learning orientations (scores on CE, RO, AC, and AE, as a combined variable) and also on solving the opposing tensions both between the abstract and concrete scales, and between the active and reflective scales (scores on AC-CE and AE-RO). Only 17% of the variance between faculties was associated with the combined scores on the four learning orientations and 14% was associated with the combined scores on solving the opposing tensions between abstract and concrete, and between active and reflective.

A further analysis for each of these dependent variables as single variables did not indicate significant differences in RO only. Students of the Faculty of Social and Political Science placed the highest emphasis on concrete experience (CE, scores = 29.77). Their relatively high emphasis on this learning orientation was significant compared to the level of emphasis of students of the other three faculties of Economics (26.28), of Mathematics and Natural Science (24.93), and of Education (25.59). Students of the Faculty of Mathematics and Natural Science placed the lowest emphasis on concrete experience.

Students of the Faculty of Economics and the Faculty of Mathematics and Natural Science placed relatively higher emphasis on abstract conceptualization (AC). Their average scores on this learning orientation were 34.85 and 34.67

respectively. These scores were significantly different from those of students of the Faculty of Social and Political Science (30.65). The economics students (34.85) were also significantly higher on AC than those of education students (32.54).

Higher emphasis on active experimentation (AE) was exhibited by students in the Faculty of Education (score = 33.29). Their scores were significantly different from students of the other three faculties including Economics (29.65), Mathematics and Natural Science (29.61), and Social and Political Science (29.39).

The extent to which students preferred abstractness over concreteness and action over reflection was indicated by their scores on AC-CE and AE-RO. The students of the Faculty of Social and Political Science did not prefer abstractness over concreteness and their scores on AC-CE were the lowest (Mean = .87) and the differences on this composite score were significant only between this faculty and the other three faculties (Economics = 8.58, Mathematics and Natural Science = 9.74, and Education = 6.96, see Table 17). Students of the Faculty of Education preferred action over reflection as was indicated by a higher positive score on AE-RO (Mean = 4.71). Their mean scores were significantly different from those of students of the Faculty of Mathematics and Natural Science (-1.17), the Faculty

of Social and Political Science (-.81), and the Faculty of Economics (.43).

The results of the normative comparison indicated that the differences in the learning orientations and in resolving the opposing tensions between abstract and concrete and between active and reflective were between the Faculty of Social and Political Science and the other faculties and also between the Faculty of Education and the other faculties. The differences between the Faculty of Social and Political Science and the other faculties were on CE, AC, and AC-CE. The differences between the Faculty of Education and the other three faculties were on AE and AE-RO (Table 10 and Table 17).

The students of the Faculty of Social and Political Science were the most concrete (significant from the other three faculties). Their concreteness was further supported both by their low abstractness and by their scores on concreteness and abstractness (AC minus CE). The students of the Faculty of Education were the most active (significantly different from the other three faculties). Their high emphasis on action was supported by their high scores between action and reflection (AE minus RO). Their high emphasis on action was also supported by their low emphasis on RO (the least reflective), but it was not significantly different from any of the other three

faculties. The high emphasis on the part of economic students on abstractness (AC) (significantly different from the other two faculties) was not supported by their score either on the opposite side (CE) or on the composite scores (AC-CE).

According to Kolb (1984), a high score on one orientation does not automatically imply a low score on its opposite, but it makes strength in the opposing orientation possible.

The normative comparison showed that students in different faculties were significantly different on emphasizing the four learning orientations, except on reflective observation. These differences might be related either to the types of students attracted to the academic field or the kind of work demanded by the academic field.

Ipsative Comparison of LSI Scores (Research Questions #2 and #3)

Research question #2 compared the relative emphasis on the four learning orientations within each faculty, and question #3 compared the relative emphasis within the total sample.

The results did not indicate significant differences within the Faculty of Social and Political Science in emphasizing the four learning orientations. The differences were significant within the other three faculties. The differences within the Faculty of Education were not significant between AC and AE. Within the

other two faculties (Economics and Mathematics), the differences were not significant between AE and RO (see Table 12). Within the total sample, the differences were also not significant between AE and RO (see Table 14).

Based on the mean scores in Table 3, the order (from the highest to the lowest) of emphasizing the four learning orientations within each faculty were: $AC > AE > RO > CE$ (Economics), $AC > RO > AE > CE$ (Mathematics and Natural Science), $AC > RO > CE > AE$ (Social and Political Science; none was significant), and $AE > AC > RO > CE$ (Education). The order of the total sample was $AC > AE > RO > CE$. The ipsative comparison indicated that almost all faculties and also the total sample placed the highest emphasis on abstract conceptualization. They did not significantly differentiate in emphasizing action and reflection. Education gave the highest emphasis on active experimentation, but it was not significantly different from abstract conceptualization (the second highest within Education). Three faculties and the total sample placed the lowest emphasis on concrete experience. Social and Political Science placed the lowest emphasis on active experimentation. Concrete experience was the second lowest in this faculty.

Learning Styles (Research Question #5)

Research question #5 was concerned with the distribution of learning styles in each faculty and in the total sample. The students' scores on the composite scores (AC-CE and AE-RO) categorized the students into each of the four learning styles. The distribution of learning styles can be found in Table 5 and in Figure 4. The faculties' learning styles, based on the average scores of the students' composite scores (see Table 4), are presented in Figure 5.

The first step in determining the students' learning styles was based on the students' scores on the four learning orientations (CE, RO, AC, and AE). According to Kolb (1984) and Smith and Kolb (1986), experiential learning is based on the idea that people learn through experience; the process is conceived of as a four-stage cycle involving four adaptive learning orientations. An effective learner needs these four learning abilities and this ideal, however, is difficult to achieve because people tend to emphasize one of the four learning orientations. The normative comparison of this study provided a comparison of students between faculties, and the ipsative comparison provided comparison within each faculty in emphasizing the four learning orientations.

The second step, as conceived by the experiential learning

theory, was that learning requires abilities that are polar opposites (between abstract-concrete and active-reflective). In this study, the second step provided information about the extent to which students emphasized abstractness over concreteness and action over reflection as indicated by the students' scores on AC-CE and AE-RO. Comparisons between faculties were also provided. Plotting these two scores as a single point of coordinate on the LSI norm (mean of AC-CE = 4.28 and AE-RO = 5.92) was the third step. The results of plotting individual's scores on AC-CE and AE-RO shows the distribution of accommodator, diverger, assimilator, and converger for each faculty (Figure 4 and Table 5). The majority of the students of the Faculty of Education were convergers (32.4%). The majority of students of the other three faculties were assimilators (Economics = 40%, Mathematics = 50%, and Politics = 38.7%). The total sample was also assimilators (37.0%). Except for the Faculty of Social and Political Science, the smallest number of students was accommodators (Economics = 10.0%, Mathematics = 13.0%, Education = 19.1%, and the total sample = 15.7%). This distribution of learning styles was significant across faculties as indicated by the results of the Chi-square test.

According to Kolb (1986), undergraduate education is one of

the major factors in shaping an individual learning style. Further, it is likely that either the process of selection into a discipline or the socialization while learning in that discipline helps shape the learning style. The average scores of students on AC-CE and AE-RO in each faculty were plotted on the LSI norm. This provided the learning style for each faculty. This single coordinate point represents the learning style of the students in each faculty or their academic major (Figure 5). However, this single point, which was based on the average scores of students in each faculty, did not represent the majority of students' learning styles either in Education or in Social and Political Science (based on the frequency of individual's scores). The average learning style of students in Education was assimilator; in Social and Political Science, it was diverger (Figure 5). Examining the distribution of learning styles, 25% of students in Education were assimilator (32.4% or the majority were convergers or more active than assimilators), and 33.9% of students in Social and Political Science were divergers (38.7% were assimilators or less concrete than divergers). It was possible that these differences related to higher scores of Education students on AE and higher scores of Social and Political Science students on CE compared to the other faculties.

Students' Achievement and Learning Styles (Research Questions #6 and #7)

Research questions number 6 and 7 addressed the relationship between GPA and learning styles.

There was no significant difference in GPA found across faculties and learning styles, and there was no interaction between faculty and learning style. Using GPA as the single criterion for achievement, students of different faculties and different learning styles did not show significantly different achievement levels. There was also no significant difference between students of different learning styles within each faculty (see means of GPA across faculties and learning styles in Table 6). Dille and Mezack (1991) did not find the learning style to be a significant variable in predicting the success or non-success of students in a telecourse study. The results of this study were not what was indicated by Kolb and Goldman (1973) and Kolb (1984) who asserted that students whose learning styles were congruent with their majors had higher achievement levels. Excluding Education, a further examination of Table 6 indicates a tendency towards higher achievement of converger students in all faculties and in the total sample. Except in the converger category, Education students tended to have higher achievement levels than did students of the others three faculties across learning styles.

Achievement between Abstract and Concrete Students and between Active and Reflective Students

Kolb (1981) recommended, based on the results of several studies on the reliability of the instrument, that researchers rely on the combination scores (AC-CE and AE-RO), as the reliability of the four basic scores was somewhat less satisfactory. In this study, the coefficient reliability of the composite scores was also higher than the coefficient reliability of the basic scores (except for AE); moreover, there was a low but significant correlation between AC-CE and GPA.

The results of the test of significant differences, as shown in Table 19, indicated that abstract students (scores higher on AC-CE) in the Faculty of Mathematics and Natural Science and in the total sample had significantly higher GPAs than did the concrete students (scores lower on AC-CE). In the other faculties, the differences were not significant, but abstract students tended to have higher GPAs than did the concrete students in all faculties. These results were similar to the results between learning styles and GPAs. Convergents, on the abstract side of Kolb's learning styles, had higher GPAs in all faculties and the total sample, except in Education. Comparison within each faculty indicated higher scores on AC within all faculties (except in Education) and within the total sample; moreover, scores on AC were the only basic scores significantly

correlated with GPA. Similar results were found by Wighton (1991) in using Kolb's four-stage cycle of learning for debriefing. His results indicated that every group which engaged in analytical debriefing (abstract conceptualization stage) scored higher in achievement. Titus et al. (1990), and Dille and Mezack (1991) found similar results. For active and reflective (see Table 20), significant differences of GPAs were found only in the Faculty of Social and Political Science. Reflective students had higher GPAs than did the active students.

Achievement between Education and Non-Education Students

Education students had significantly higher GPAs than did the non-education students. Education students were mostly convergers, and non-education students were mostly assimilators. However, there was no significant difference in achievement level associated with learning styles. This means that students in both education and non-education, whose learning styles were different, had no significant difference in their achievement. A further examination of the data in indicates that education students had higher GPAs than students of the other faculties across learning styles. The exception was the converger category.

To understand this may relate to the environment at

Universitas Terbuka. The entry qualifications for education and non-education faculties applied at Universitas Terbuka are different and these differences may be associated with the differences in achievement. For non-education faculties, the applicants are only required to have a high school diploma. For the degree program in Education, the applicants are required both to be teachers in secondary schools and to have a 3-year diploma in a related field.

Overall Interpretation: Kolb's Learning Styles and Educational System at Universitas Terbuka

The components of Kolb's learning styles based on experiential learning were: the four basic learning modes or orientations (scores on CE, RO, AC, and AE), composite scores (scores on AC-CE and AE-RO), and the four learning style types (accommodator, diverger, assimilator, and converger).

The four basic learning modes indicated how much the students relied on the four different learning modes that were part of the four-stage cycle of learning. The results of the normative comparison provided a comparison of each of these learning modes between faculties. Compared to the other students, students of the Faculty of Social and political Science (Developmental-Administration study program), as indicated by their higher emphasis on CE, emphasized personal involvement

with people in everyday situations, tended to rely on feelings rather than a systematic approach, and relied more on their ability to be open minded and adaptable to change (Kolb, 1985). Education students (Mathematics-in-Education study program), as indicated by their higher scores on AE, learned in an active way, had a practical approach and a concern with what really works as opposed to watching a situation, and valued getting thing done (Kolb, 1985). Economic students (Management study program) and Mathematic students (Applied-Statistics study program), as indicated by their higher scores on AC, emphasized the use of logic and ideas rather than feelings to understand problems or situations, relied on systematic planning, and developed theories and ideas to solve problems (Kolb, 1985).

As indicated by the non-significant difference on RO, students of the four faculties did not give significantly different emphasis to understanding ideas and situations from different points of view, to relying on patience and careful judgment, and to relying on their own thoughts and feelings to form opinions (Kolb, 1985). As stated by Kolb (1984), the lack of significant differentiation in a given learning mode (in this study, RO) might be a result of more uniform selective and normative pressures toward reflective observation. This in fact, may be the case of

Universitas Terbuka. Except for education, Universitas Terbuka applies the same entry requirements for all faculties. The teaching-learning conditions, such as instructional media and student assessment, were almost completely the same for all students. The students were given printed materials as the main instructional media written by authors who followed the same guidance which contained general objectives and specific instructional objectives provided by the university. There were home assignments (20% of the final grade) and final examinations (80% or 100% without doing the home assignments). These student assessments were in multiple choice form. Students were required to have GPAs of not less than 2.00 (equal to C in ABCDE grading system) and to get a grade of at least C in State Ideology before taking the comprehensive examination. Except for education students, the university required all students to take general basic courses (State Ideology, Indonesian, Religion, Military Education, Basic Natural Science, and Basic Cultural Science) (Universitas Terbuka, 1992). The first objective of the curriculum for each study program at Universitas Terbuka was to ensure that the students have attitudes and awareness of the state and the community that conformed to the state ideology (Pancasila). Given Kolb's idea of degrees of orientation of educational

programs toward each of the four learning modes, it may be that the general requirements and curriculum demands of Universitas Terbuka do, indeed, influence the students' learning style orientation.

The ipsative comparison provided a comparison of the four learning modes both within each faculty and within the total sample. The results of this comparison indicated, except for education, the same emphasis within all faculties and within the total sample. The students within each of the three faculties and within the total sample placed relatively higher emphasis on abstract conceptualization (not significant in Social and Political Science). Within the Faculty of Education, where the students were required to be teachers, the highest emphasis was on active experimentation. Their emphasis on AE was significantly different from their emphasis on RO. Students in the other three faculties and the total sample did not differentiate AE and RO. The Education students, in addition to fulfilling the requirement of having already worked as teachers, were also required to take a course in the teaching-learning process in addition to the other core courses that students of the other faculties were required to take. In this sample (Mathematics-in-Education study program), they had to take a course in teaching mathematics. Both of these requirements for education students

was likely associated with the high emphasis of education students on active experimentation.

As mentioned, the greatest emphasis within the three faculties and the total sample was on AC. The highest emphasis within Education was AE, but it was not significantly different from AC (The mean scores were 33.29 and 32.54 respectively.). This high emphasis within almost all faculties and the total sample on AC was probably the result of the learning environment. According to Kolb (1984), any educational program or course design can be viewed as having degrees of orientation toward each of the four learning modes. He further indicated that symbolically complex learning environments (the highest degree of emphasis was on AC) were the learning environments in which the learners were involved in trying to solve problems for which there were right answers or best solutions. Students of Universitas Terbuka are mostly evaluated by multiple choice questions until they are allowed to take the comprehensive examination (when they are within 15 units of the total 150 units). It may be that the course and examination demands impose, in a sense, a particular style on the learners.

The second component of the LSI is the composite scores. These scores were closely related to the basic scores or the four learning modes as indicated by the normative comparison made

in this study (significant differences of CE and AC between Social and Political Science and the other three faculties were related to AC-CE, and significant differences of AE between Education and the other faculties were related to AE-RO.). Kolb (1985) mentioned that there was no single mode of the four basic learning modes which described each person's learning style, since each person's learning style is a combination of the four basic learning modes. These combinations represent the third component of Kolb's notion of learning styles: accommodator, diverger, assimilator, and converger.

Except for the Faculty of Social and Political Science, the other faculties and the total sample were assimilators. Kolb (1985) identified assimilators as learners who understood a wide range of information and put it into concise and logical form, did not focus much on people but on abstract ideas and concepts, and found the logical soundness of a theory was more important than practical value. Divergers (Social and Political Science) viewed concrete situations from many different points of view, observed rather than took action in approaching the situations, enjoyed situations that called for generating a wide range of ideas, had broad cultural interests, and liked to gather information.

In his typology of disciplines, Kolb (1984) clustered natural

sciences and mathematics in the abstract/reflective quadrant (assimilator), humanities and social sciences in the concrete/reflective quadrant (diverger), social professions in concrete/active quadrant (accommodator), and science based professions in abstract/active (converger). On a career map, Kolb (1985) and Smith and Kolb (1986) clustered six kinds of careers. The cluster in accommodator consisted of careers in organizations, business, and promotion; in diverger, the cluster consisted of careers in arts and entertainment, and service organizations; in assimilator, the clusters consisted of information careers (including the fields of education and jobs as teachers) and careers in science (including the field of mathematics); and in converger, were clustered careers as specialist and technological careers.

The findings of this study indicated that the Education faculty's learning style was assimilator. This result was the same as the cluster described Kolb (education, teacher, and mathematics were assimilators). However, it was different from the results of the distribution of learning styles which were based on the frequency of individual scores. The distribution indicated that the majority of education students were in the converger category (more active) and both basic and the composite scores indicated that the learning styles of education

students were more active.

Kolb's finding (1984) revealed that managers and students of a technological university whose undergraduate majors were mathematics were assimilators. For Mathematics and Natural Science (Applied-Statistics study program), the faculties' learning style and the majority was the same as this cluster. It must be noted that Kolb did not cluster statistics.

Kolb, in his typology of disciplines, clustered humanities and social sciences on diverger category. This cluster was similar to the results of this study which indicated that Social and Political Science (Developmental-Administration study program) was diverger. Kolb (1984) found that managers, whose undergraduate majors were political science, were divergers. In the career map, administrator and politician were accommodators.

According to Kolb (1984), the interaction among career, high level of education, and undergraduate major may produce distinctive learning styles. Stumpf and Freedman (1981) stated that the clinical use of instruments like the Kolb's LSI demanded a high degree of measurement precision. Besides academic major (educational specialization), Kolb identified personality type, professional career, current job, and current task as also shaping learning styles. This study only controlled academic

major (the study program in each faculty) and the minimum units students had taken (60 units) to indicate their relative adaptation with their major. The demographic data gathered in this study that may have been associated with the results were respondents' occupations and educational backgrounds. There were 105 respondents whose occupations were related to the study programs they were taking, and there were 98 respondents whose educational backgrounds before registration at Universitas Terbuka related to the study programs they were taking.

The other demographic data were age, year of registration, and the number of units taken. In the relationship with age, the data of the LSI norm (Smith & Kolb, 1986) revealed that 47% of the sample who were between 18-24 years old were active and 62% of the sample who were above 45 years old were active. In other words, the older the individuals the more active their orientation are. The distributions of age in this study were 18.4% up to 30, 28.1% between 31-35, 24.0% between 36-40, 15.3% between 41-45, 9.7% between 46-50, and 4.6% above 50. More than 60% of the respondents were between 30 and 45. The data revealed that the average style of the respondents was in the reflective side rather than in the active side.

In interpreting the relationship between GPA and learning

styles, it was helpful to examine the data on student achievement. The data on GPA gathered in this study revealed that only 32 students (14.78%) of the total sample (216 students) had GPAs higher than 2.00 (equal to C). The total mean of the GPA was 1.59 ($SD = .39$). Another study at Universitas Terbuka, presently being conducted by a graduate student, revealed that only 1,350 students (17.77%) of the total sample (7,892 students) had GPAs higher than 2.00. Conducting a study of student achievement at Universitas Terbuka using GPA might be more useful if the students were grouped according to their level of GPA (for example: low, middle, and high) before they are randomly selected. Other data that may have related to achievement were the number of units the students had taken. There was 22.7% of the total sample that had taken more than 160 units (7.9% more than 190 units). They were required to take between 150-160 units for graduation with a GPA not less than 2.00. It was possible that some students tried to take other courses when they failed in a course or that they took some other courses before they knew they had failed.

Conclusions and Summary

The general conclusions and summary are presented in this section. The overall implications and specific recommendations are presented in Appendix D.

Both the uniform selective and normative pressures, or uniform entry requirements, and the teaching-learning process applied at Universitas Terbuka as a distance-education institution may be associated both with the tendency of the students from different faculties to have the same emphasis on reflective observation and with similar tendency of the students within each faculty to place more emphasis on abstract conceptualization. The students' learning styles tended to be on the abstract side. This abstractness was likely related to higher levels of achievement rather than to the type of learning style. Education students tended to be different (higher achievement and more active) from other students. The requirement being a teacher for applicants at the Faculty of Education might be related to these differences. Students within the Social and Political Science Faculty did not differentiate significantly among the four learning modes.

Students of the four faculties, represented by one study program in each faculty, were significantly different in

emphasizing the four learning orientations (modes, scores on CE, RO, AC, and AE) . They also performed differently in the combination between abstract and concrete (scores on AC-CE) and between active and reflective (scores on AE-RO) two dimensions reflected in the Kolb's experiential learning theory.

As for the relative emphasis placed on the four learning modes, students of the four faculties were significantly different in emphasizing concrete experience, abstract conceptualization , and active experimentation, but not in reflective observation. The significant difference on concrete experience was between Social and Political Science and the other three faculties and students in this faculty were the highest in emphasizing concrete experience. They were also the lowest in emphasizing abstract conceptualization, and this was significantly different from the levels of emphasis of students in Economics and Mathematics and Natural Science. Economic students were the highest in the AC mode. Education students were significantly different from the students of the other faculties in active experimentation, placing the strongest emphasis on this mode.

The highest emphasis on concrete experience and the lowest emphasis on abstract conceptualization of the students in Social and Political Science were related to their lowest preference for abstract over concreteness (AC-CE), and the difference was

significant from those of students from the other faculties. The relatively highest emphasis on active experimentation of Education students was also related to their preference for action over reflection (AE-RO).

Almost all students within each faculty, including the total sample, tended to emphasize abstract conceptualization over than the other modes. However, within Education, abstract conceptualization was the second highest after active experimentation, although these two modes were not significantly different. Only Education significantly differentiated active experimentation and reflective observation. Social and Political Science also had the highest emphasis on abstract conceptualization, but none of the learning modes was significantly different from each other.

Overall, the learning styles of students at Universitas Terbuka were mostly on the abstract side (converger and assimilator). Education students were mostly convergers and students of the other three faculties and the total sample were mostly assimilators (Figure 4 and Table 5). The smallest number of students was accommodators. The average composite scores put Social and Political Science in the diverger category and put the other three faculties and the total sample in the assimilator category.

The overall learning styles found in this study, calculated as the combination of two composite scores, were not associated with different achievement, although the abstractness category was more likely associated with achievement. Abstract students tended to have a higher GPA than did the concrete students, and the differences were significant both in the Faculty of Mathematics and Natural Science and in the total sample. Significantly high levels of achievement by reflective students were found only in the Faculty of Social and Political Science.

In summary, to place the study in a more global context requires considering several interacting ideas. It is widely accepted that the learner and learning environment interact in a multiplicity of ways, and delineating the features of both learners and the environment has been the substance of many research projects. Kolb's (1984) concepts of experiential learning, learning styles and his instrument, the LSI, have gained widespread acceptance as addressing one learner characteristic. Kolb's notions have been tested in a very limited way both in non-traditional settings, such as distance education, and in different cultural context; it is that fact that produces the theme of and questions asked in the current study. The basic question addressed centres on measuring the fruitfulness of the LSI both in a non-traditional distance education institution, Universitas

Terbuka, and in a different cultural context, Indonesia. Given the current data, it is safe to assume that, with some exceptions, the LSI may, indeed, be a useful tool in addressing the learner-environment interaction in different cultural settings.

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APPENDIX A**Results of Reliability Analysis using Cronbach's Alpha**

Items	Alpha if Item Del.	Reliab. Coeff.	Items	Alpha if Item Del.	Relieb. Coeff.
CE-1	0.704	0.734	RO-1	0.658	0.698
CE-2	0.694		RO-2	0.669	
CE-3	0.742		RO-3	0.710	
CE-4	0.715		RO-4	0.679	
CE-5	0.713		RO-5	0.680	
CE-6	0.697		RO-6	0.659	
CE-7	0.727		RO-7	0.641	
CE-8	0.722		RO-8	0.697	
CE-9	0.696		RO-9	0.662	
CE-10	0.735		RO-10	0.705	
CE-11	0.714		RO-11	0.658	
CE-12	0.734		RO-12	0.714	
AC-1	0.698	0.725	AE-1	0.767	0.795
AC-2	0.703		AE-2	0.780	
AC-3	0.734		AE-3	0.786	
AC-4	0.721		AE-4	0.768	
AC-5	0.698		AE-5	0.777	
AC-6	0.690		AE-6	0.783	
AC-7	0.698		AE-7	0.771	
AC-8	0.696		AE-8	0.781	
AC-9	0.714		AE-9	0.772	
AC-10	0.704		AE-10	0.791	
AC-11	0.726		AE-11	0.786	
AC-12	0.703		AE-12	0.803	
AC.CE-1	0.740	0.763	AE.RO-1	0.760	0.789
AC.CE-2	0.735		AE.RO-2	0.772	
AC.CE-3	0.776		AE.RO-3	0.791	
AC.CE-4	0.751		AE.RO-4	0.763	
AC.CE-5	0.736		AE.RO-5	0.769	
AC.CE-6	0.724		AE.RO-6	0.767	
AC.CE-7	0.749		AE.RO-7	0.751	
AC.CE-8	0.743		AE.RO-8	0.780	
AC.CE-9	0.740		AE.RO-9	0.762	
AC.CE-10	0.756		AE.RO-10	0.790	
AC.CE-11	0.754		AE.RO-11	0.768	
AC.CE-12	0.754		AE.RO-12	0.803	

APPENDIX B**Results of Validity Analysis using Factorial Analysis**

Items	Factor 1	Factor 2	Items	Factor 1	Factor 2
CE-1	-0.0625	-0.6195	RO-1	0.4765	0.1239
CE-2	-0.1416	-0.6607	RO-2	0.4404	0.0338
CE-3	0.0992	-0.0669	RO-3	0.1682	0.1904
CE-4	0.0888	-0.5941	RO-4	0.4337	0.2270
CE-5	0.0070	-0.4579	RO-5	0.4363	0.1621
CE-6	-0.1371	-0.6859	RO-6	0.5434	0.1565
CE-7	0.0614	-0.4374	RO-7	0.6661	0.0504
CE-8	0.0478	-0.3600	RO-8	0.2178	0.1049
CE-9	0.0857	-0.6945	RO-9	0.5318	0.3241
CE-10	0.1922	-0.2293	RO-10	0.0214	-0.3833
CE-11	0.0438	-0.3951	RO-11	0.5519	0.0866
CE-12	0.1283	-0.2183	RO-12	0.0512	-0.1533
AC-1	0.1695	0.3709	AE-1	-0.6479	0.1272
AC-2	-0.0022	0.4705	AE-2	-0.5445	0.1272
AC-3	0.0989	0.2786	AE-3	-0.4189	0.0323
AC-4	0.2247	0.2752	AE-4	-0.6900	0.0054
AC-5	0.1839	0.5437	AE-5	-0.6150	-0.2114
AC-6	0.0435	0.6159	AE-6	-0.4747	0.0217
AC-7	-0.0449	0.4353	AE-7	-0.6288	-0.0516
AC-8	0.2740	0.4327	AE-8	-0.5280	0.0538
AC-9	0.1096	0.1920	AE-9	-0.6132	0.1293
AC-10	0.1063	0.4951	AE-10	-0.3657	0.1314
AC-11	-0.1199	0.3040	AE-11	-0.4890	0.0500
AC-12	0.1112	0.3654	AE-12	-0.2842	0.0559

APPENDIX CDemographic Data

1. Age (Frequencies and Percentages)

Range	Economics	Math.&Nat.	Soc.&Pol.	Education	Total
≤ 30	4 11.1%	14 38.9%	10 27.8%	8 22.2%	36 18.4%
31-35	6 10.9%	10 18.2%	20 36.4%	19 34.5%	55 28.1%
36-40	11 23.4%	9 19.1%	13 27.7%	14 29.8%	47 24.0%
41-45	6 20.0%	4 13.3%	10 33.3%	10 33.3%	30 15.3%
46-50	3 15.8%	4 21.1%	1 5.3%	11 57.9%	19 9.7%
51-60	3 33.3%	1 11.1%	2 22.2%	3 33.3%	9 4.6%

2. Year of Registration (Frequencies and Percentages)

Year	Economics	Math.&Nat.	Soc.&Pol.	Education	Total
1984	22 31.9%	35 50.7%	12 17.4%	-	69 34.5%
1985	5 14.3%	5 14.3%	25 71.4%	-	35 17.5%
1986	6 9.1%	2 3.0%	18 27.3%	40 60.6%	66 33.0%
1987	-	-	3 15.8%	16 84.2%	19 9.5%
1988	-	-	-	5 100%	5 2.5%
1989	-	-	-	4 100%	4 2.0%
1990	1 50.0%	-	-	1 50.0%	2 1.0%

3. Number of Units (Frequencies and Percentages)

Range	Economics	Math.&Nat.	Soc.&Pol.	Education	Total
≤ 100	7 7.5%	8 8.6%	12 12.9%	66 71.0%	93 43.1%
101-130	10 25.0%	11 27.5%	18 45.0%	1 2.5%	40 18.5%
131-160	9 26.5%	9 26.5%	15 44.1%	1 2.9%	34 15.7%
161-190	7 21.9%	11 34.4%	14 43.8%	-	32 14.8%
191-220	5 41.7%	5 41.7%	2 16.7%	-	12 5.6%
> 220	2 40.0%	2 40.0%	1 20.0%	-	5 2.3%

4. Educational Background (Related and Not Related to the Study Program)

	Economics	Math.&Nat.	Soc.&Pol.	Education	Total
Related	13 13.3%	24 24.5%	4 4.1%	57 58.2%	98 53.5%
Not	19 22.1%	15 17.4%	48 55.8%	4 4.7%	86 46.7%

5. Occupation (Related and Not Related to the Study Program)

	Economics	Math.&Nat.	Soc.&Pol.	Education	Total
Related	23 21.9%	11 10.5%	9 8.6%	62 59.0%	105 53.0%
Not	12 12.9%	28 30.1%	49 52.9%	4 4.3%	93 47.0%

APPENDIX D

Implications and Recommendations

Implications

Contexts of the Implications

There are contextual conditions related to Kolb's learning styles and to the educational system at Universitas Terbuka that must be considered for implications. Some important contexts for implications related to Kolb's learning styles, as the theoretical base for this study, are:

1. Learning style is not a fixed trait;
2. None of the four learning modes is better or worse than the others;
3. A balanced emphasis of the four learning modes is not the best;
4. The ability to be flexibly competent in each mode when it is called for is more important;
5. The instrument provides guidance for improving learning; and
6. The educational program or course design has degrees of orientation toward each of the four learning modes (Kolb, 1984 and Smith & Kolb, 1986).

Considering Kolb's ideas in the Universitas Terbuka context involves considering the following points:

1. Universitas Terbuka provides both general and specific instructional objectives as guidance for module writers;
2. exercises and final examinations are based on these objectives;
3. the cognitive processes in the Table of Item Specifications are based on Bloom's taxonomy of cognitive process (knowledge, comprehension, application, analysis, synthesis, and evaluation).
4. students joining study groups receive additional services (tutorial, information) from the university; and
5. Universitas Terbuka does not provide different study materials for the different learning styles of students.

Providing and Evaluating the Learning Environment

Universitas Terbuka provides learning environments for the students through its printed materials, academic services, and examinations. These learning environments may influence the degrees of orientation towards each of the four learning modes (CE, RO, AC, and AE). The examinations measure the contents of the modules since the examinations and the contents of the modules are based on the same objectives. The cognitive processes applied at Universitas Terbuka are based on Bloom's taxonomy: knowledge, comprehension, application, analysis,

synthesis, and evaluation. These cognitive processes can be related to the four learning modes: concrete experience, reflective observation, abstract conceptualization, active experimentation. The degrees of orientation toward each of the learning modes can be related to the Table of Item Specifications containing percentages of each of the cognitive processes.

The aforementioned are the course level contexts of learning environments. According to Kolb (1984), the larger and more difficult context is the institutional context, such as the mission and educational the philosophy of the university. Smith and Curran (1989) suggested that educational philosophy of distance education should aim at achieving more understanding than mere rote learning or memorization. It must develop in its students the abilities to question, to think critically, and to organize their thought processes in logical and rational ways. This educational philosophy has implications for learning materials and evaluation. The evaluation is implemented in the form of a Table of Item Specifications. According to Morgan (1991), student evaluation with the emphasis on reproducing information can lead students to adopt surface approaches to study (concentrate on memorizing the facts and details, poor understanding but with knowledge of detail).

Matching the Styles and the Learning Environments

Universitas Terbuka, as a large-scale distance education institution, does not provide different study materials to accommodate different types of learners. Its educational philosophy, curriculum objectives, study materials, and student evaluation (examinations) are related. Its students are in close touch with the study materials and examinations as their main learning environment which has degrees of orientation toward concrete experience, reflective observation, abstract conceptualization, and active experimentation.

According to Kolb (1984), people enter learning environments with already-developed learning styles. A learning environment which is dissimilar to the student's preferred style of learning is likely to be rejected or resisted by that student. Gaining an insight into how the subject matter is taught, how the student is evaluated, and what adjustments the students need are all ways to match learning styles and the learning environments. Universitas Terbuka provides an overview in each module containing a brief description of the contents, the usefulness of the course, the objectives, and the best way to learn that module. This overview is more subject-oriented. An orientation for the students about how to learn the module which is related to the four learning modes should be

considered.

Kolb (1985) identified strategies to improve learning which were related to his learning-style theory. They include 1). developing a supportive relationship; 2). improving the match between learning style and life situation; and 3). becoming a flexible learner. One way that developing a supportive relationship can be accomplished is by studying with students who have different styles. Students at Universitas Terbuka have an opportunity to study in a group since the university encourages the students to form study groups. Improving the match between learning style and life situation has a more practical meaning in the selection of the study program that the students can take. Becoming a flexible learner can be accomplished by developing the learning strengths and reducing the weaknesses. All these strategies encourage the students to adjust to the learning environments, but Universitas Terbuka should attempt to provide a learning environment which relates to the condition of the students.

A more representative sample is needed in order to get a more representative picture of the students' emphasis on the four learning modes. The percentage of each level of cognitive processes in the Table of Item Specification can be developed based on this condition. The results of this study indicate that

most students placed greater emphasis on abstract conceptualization and that the abstract students tended to have higher achievement levels. According to research reviewed by Kolb (1984), the learning ability of the students who score higher on abstract conceptualization was enhanced by symbolically related factors such as case studies, thinking alone, and theory reading.

Recommendations

The conclusions reached in this study may not be applicable to the whole population of Universitas Terbuka and a more representative sample is recommended. The sample should represent the fields of study in each faculty. For example, in Education, the sample should represent the fields of mathematics, social science, and natural science. Since the student population is very large, it is better to have an LSI norm for Universitas Terbuka than to use the LSI norm developed in the U. S. A.

There must be empirical data indicating the relationships between the level of cognitive processes applied for examinations as one of the main indications of the learning environments and the learning modes. The study can be conducted by relating percentage of correct answers of each

cognitive process (from item analysis) and scores of the four learning modes (from the responses on Kolb's LSI).

The normal time needed to complete the Kolb's LSI is about 10 to 15 minutes. The format of LSI is a forced-choice ranking format in order to create a solution of conflicts among the four learning modes and to control a tendency of responding higher on items that are socially desirable, as in a Likert scale. Since completion of the questionnaire is beyond the control of the researcher, it is possible that the students who are completing the questionnaires at home take more time and have a chance to evaluate their responses. As far as possible, it would be better if the sample included students taking both examination and tutorial.

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