
Yamazaki, Yoshitaka, Verena Murphy, and Mauricio Puerta

WP-03-03

Copyright
Department of Organizational Behavior
Weatherhead School of Management
Case Western Reserve University
Cleveland OH 44106-7235
e-mail: pxp36@po.cwru.edu
Learning Styles and Learning Skills in Higher Education: An
Empirical Study of their Relationship Using Kolb’s Experiential Learning Theory

Yoshitaka Yamazaki, Verena Murphy, and Mauricio Puerta

Department of Organizational Behavior

Weatherhead School of Business

Case Western Reserve University
Abstract

We present an examination of learning styles and learning skills in higher education using Kolb's Experiential Learning Theory. Our primary goal in this study is to understand how students' learning styles have an impact upon the development of their learning skills in higher education. Secondly, this study aims to understand what learning styles are typically shown in the learning preference of students in higher educational institutions. For these purposes, we analyzed 288 students who just enrolled as freshmen in a Mid-Western university. Our results revealed that students' learning styles significantly affect learning skills in one dialectical learning-dimension between concrete experience and abstract conceptualization, whereas they marginally influence learning skills in the other learning-dimension between reflective observation and active experimentation. In addition, our freshman sample as a whole displayed that they tend to be strongly oriented toward the analytical learning mode. The implication of this study will be discussed.
INTRODUCTION

Obviously, educational institutions are looking for effective strategies for attracting and retaining students, and securing their success (Brow, 1986; Carney & Hopperstead, 1986; Maisey, Hartman, Brunson, & Whiteman, 1986; Pascarella, 1986; Green & Parker, 1989). Knowles (1973) indicates that understanding how people learn is a primary requirement for a successful pedagogical program. Hunt (1979) argues that certain educational approaches serve more effectively for students’ learning than others because students differ in how they learn. In line with their views, if the central mission of educational institutions is to facilitate students’ learning, understanding students’ ways of learning may be one of the pivotal keys to lead to successful educational institutions in which students are expected to acquire skills and knowledge necessary for their adaptation to the world.

Regardless of the important subject concerning students’ different ways of learning, educators and their institutions at this time pay limited consistent attention to understanding how students learn in higher educational systems (Sims & Sims, 1995; Kiernan, 1979), and how students’ learning styles are associated with the competencies or learning skills (for review, see Kolb and Kolb, 2003). In addition, educators and their institutions may also not differentiate enough the way of students’ learning from a set of academic skills they need to acquire. A recent article titled “Learning to learn: more than a skill set” argues that ‘learning to learn’ is different from acquiring a skill set and should receive thoughtful attention in higher education (Rawson, 2000, p.225). The question of learning to learn could be focused on the processes of people’s learning: that is, the concept of learning style. Curry (2000) defines learning styles as “individual
consistencies in perception, memory, thinking, and judgment across any stimulus condition” (p.239). Keefe (1979) illustrates that learning styles refer to cognitive, affective, and physiological behaviors that perform as relatively stable indicators of how people perceive, interplay with, and respond to, their environment in learning situations. With regard to the relationship between ‘learning styles’ and ‘skills’, Kolb (1984) discusses that learning style involves the facilitation and development of a general class of more particular skills necessarily required from proximate environmental circumstances. Learning style, therefore, represents more fundamental and generic dimensions of individual learning, whereas a learning skill describes more specific and situational dimensions in immediate environments (Kolb, 1984; Boyatzis & Kolb, 1991 and 1995). The primary purpose of this study is to examine the question of how such learning styles have an impact upon the development of learning skills in higher education using Kolb’s (1984) Experiential Learning Theory (ELT).

According to Kolb’ learning model, people display individual differences in their preferred styles of learning reflected with the four learning modes theorized in ETL. In terms of ELT learning skills, there are twelve skills that are conceptually structured as four learning areas, each area of which consists of three learning skills. While there have been many ELT studies whose purpose is mainly to investigate and identify learning styles in various learning situations (Kolb, Boyatzis, & Mainemelis, 2001), there is very little research about the relationship between ELT learning styles and learning skills in higher education with the exception of two recent studies (Mainemelis, Boyatzis, & Kolb, 2002; Davies, Rutledge, & Davies, 1997). Mainemelis et al. discussed how the four learning modes have an effect on their concomitant four areas of learning skills. Our
empirical study tested further the impact of the four learning modes upon the twelve learning skills, in an attempt to corroborate their theoretical relationship.

Finally, Barnett (1994) states that the principal purpose of higher education is related to the development of critical thinking. In fact, the National Postsecondary Education Cooperative Working Group (see Hersh & Benjamin, 2002) illustrates critical thinking together with problem solving, analytical, evaluative skills, and reasoning skills as the higher-order cognitive skills out of the twelve categories that can be assessed as student outcomes that are potentially affected by the college experience. It is obvious that these above described cognitive skills are affected by the particular educational specialization throughout the students’ college experience, which may promote certain learning styles. In this respect, it is assumed that educational institutions like research universities, which focus on the development of critical thinking, may tend to select students who more strikingly exhibit those fundamental abilities, such as critical thinking or analytical reasoning. This assumption will result in the dominance of students who have a learning style relevant to those abilities. In harmony with the issue of understanding students’ learning styles in higher education, we examined the question what kind of learning styles are dominant in the group of selected undergraduate students who just entered into a research university as freshmen.

LEARNING STYLES AND LEARNING SKILLS BASED ON ELT

This section aims to produce hypotheses about the relationship between ELT learning styles and academic learning skills in higher education. Towards this end, we will discuss a conceptual framework concerning these hypotheses based on Kolb’s ELT
such as (1) the experiential learning processes and cycles, (2) four basic learning abilities and learning styles, (3) learning styles and learning skills as two adaptive competencies, and (4) interplay between students and their environments in higher education.

The Experiential Learning Processes and Cycles

By integrating and developing the experiential works of Dewey (1958), Lewin (1951), Piaget (1971), James (1890), Jung (1960), and Freire (1973, 1974), Kolb (1984) established the Experiential Learning Theory (Kolb, 2002). This theory articulates the central role of experience as essential in the learning process, reflecting the wholeness of human learning through feeling, reflecting, thinking, and doing (Kolb, 1984). Kolb (1984) illustrates that the learning process lies in the bases of four adaptive learning modes that create the experiential learning cycle (Mainemelis, Boyatzis, & Kolb, 2002). Immediate concrete experiences (CE) establish the foundation for observation and reflection (RO), which transforms the apprehensive experiences which are then integrated into abstract conceptualization (AC), from which active experimentation (AE) is derived. This active experimentation then entails generating here-and-now concrete experiences. When the cycle is completed, it begins in a new way. The recent study of Zull (2002) supports this learning cycle from a biological perspective of the human brain mechanism. In the ELT learning cycle, the CE mode is dialectically faced against the AC mode as a way of grasping experiences, whereas the RO mode is in dialectical opposition to the AE mode in a transformation process of such grasping experiences (Kolb, 1984).
Four Basic Learning Abilities and Learning Styles

In ELT, the person is required to employ each of the four key learning abilities at the base of these four adaptive modes in order to be an effective learner (Kolb, 1984). CE abilities focus on being involved in experiences and dealing with immediate human situations subjectively. The emphasis of CE abilities is to use feeling and sensitivities to peoples' feelings and values. Those with CE abilities value interpersonal relations and are good at relating to people with an open-minded approach. In contrast, AC abilities call for applying logic, ideas, and concepts. The AC abilities are centered on thinking, analyzing, and building conceptual models. Those with AC abilities are good at making systematic plans, manipulating abstract symbols, and using quantitative analysis.

RO abilities involve understanding the meaning of ideas and situations by carefully watching and listening. The focus of RO abilities is to employ reflective understanding to find out how and why things happen. Those with RO abilities are good at imagining the meaning of situations and thoughts and looking at things from various perspectives in an appreciative manner. In contrast, AE abilities demand actively influencing people and changing situations. The emphasis of AE abilities is to make practical applications and to be pragmatic with what actually works. Those with AE abilities are willing to take risks and take action to get things done and seek to have responsibility for objectives and achievements.

A combination of two adaptive learning modes makes the four fundamental types of learning styles, each style possessing and encompassing, concomitant learning abilities (Kolb, 1984; Kolb & Fry, 1975). The Diverging learning style specializes in the two modes CE and RO, while the Converging learning style specializes in the two modes AC.
and AE. The Assimilating learning style specializes in AC and RO, whereas the Accommodating learning style specializes in CE and AE. Figure 1 describes Kolb’s experiential learning model.

Learning Styles and Learning Skills as Two Adaptive Competencies

Learning styles involve four learning abilities and refers to generic adaptive competencies to the environment, while learning skills reflect more situational, specific competencies required for effective performance on a variety of tasks (Kolb, 1984; Boyatzis & Kolb, 1991 and 1995). In terms of the relationship between learning styles and learning skills, learning styles represent “higher-level learning heuristics that facilitate the development of a generic class of more specific skills” demanded from immediate environments (Kolb, 1984, p.93). This relationship may be seen in Curry’s three-layer ‘onion’ model (Boyatzis & Kolb, 1991) that is built on her study of 21 cognitive and learning style instruments.

Curry (1987) explains that the outer layer of the onion model is the most observable and “interacts most directly with learning environments, learners’ expectations, teachers’ expectations and other external features” (p.7). This layer seems to be most related to the concept of learning skills of ELT because interplay between persons and their situational environment makes a difference to them. Such interplay produces a specific skill that can be observed during people’s performance when they are
to meet particular demands imposed by their proximate environments. The middle layer of the onion model represents the information processing dimensions “as a set of processes that function at the intersection between fundamental personality levels individual differences and environmentally offered learning format choices” (Curry, 1987, p.11). ELT learning styles that are examined through the Learning Style Inventory (Kolb, 1971, 1976, 1985, and 1999) are categorized as this second layer (Curry, 1987). Since ELT learning styles reflect the transaction between personality traits and socio-cultural environmental factors such as family, school, and work (Kolb, 1981 and 1984; Kolb & Fry, 1975), they are associated with this middle layer. Additionally, the innermost layer of the onion model concerns cognitive personality dimensions that are characterized as being “underlying and relatively permanent personality” (Curry, 1986, p.14). Her model is similar to ELT’s three level model of human development that explains three modes of people’s adaptation to the world (Boyatzis & Kolb, 1991).

A classification of learning skills as specific adaptive competencies are in accord with the following learning style descriptions of ELT (Boyatzis & Kolb, 1991 and 1995): The CE mode of learning reflects the development of an area of the interpersonal (CE) skill such as: relationship skills, leadership skills, and the skills of helping and understanding people (Kolb, 1984; Boyatzis & Kolb, 1995; Rainey, Hekelman, Galakza, & Kolb, 1993). The RO mode encompasses the development of an area of the perceptual (RO) skill such as: sense-making skills, information gathering skills, and information analysis skills. The AC mode involves the development of an area of the analytical (AC) skill such as: theory building skills, quantitative analysis skills, and technology management skills. Finally, the AE mode includes the development of an area of the
behavioral (AE) skill such as: goal setting skills, action skills, and initiative skills. Figure 2 illustrates the relationship between the four learning modes and the learning skill typology that is composed of the aforementioned 12 skills.

Insert Figure 2 about here

Interplay Between Persons and their Environments in Higher Education

Individual learning styles and skills, that is, generic adaptive competencies and specific adaptive competencies, involve interplay between people and the world (Kolb, 1984; Boyatzis & Kolb, 1991, 1995). Kolb (1984) further explains that such interplay shapes learning styles at five levels: psychological types, educational specialization, professional career, current job, and adaptive competencies (Kolb, Boyatzis, & Mainemelis, 2001). The fundamental learning styles of most people are developed at those levels by emphasizing some learning modes over others, and as has been discussed previously, refer to the four basic styles of learning (Kolb, 1984). This perspective about the involvement of the interplay is consonant with a concept of Lewin’s theoretical formulation, \( B = f(P, E) \) which indicates that “behavior is a function of the person and the environment” (Kolb, 1984, p.36).

We can think of it as interplay between the person (at one end of the pole) and the environment (at the other end of the pole), with learning style being the result of the interaction of the two poles. Kolb (1984) argues that the person factor moderately but pervasively exerts an influence on learning styles in most situations, whereas the
environment factor somewhat more strongly affects learning styles, but its influence is more situational and specific. When we pay more attention to the role of environment in the development of learning styles, there is a certain pattern of learning styles in accordance with each environmental characteristic in the five levels. For example, it can be seen that the predominant learning style of undergraduate students is mapped in the two dialectical learning dimensions according to their academic majors (Kolb, 1981, 1984).

With this notion, educational specialization entails remarkably influential components in higher education, especially undergraduate, graduate, or even high school institutions. As a task of education, such pedagogical institutions form students' attitudes towards learning and the development of effective learning skills (Kolb, 1984). It is reasonable to infer that those learning styles and learning skills to be developed by students are matched with the institutional goals. Educational institutions pursue the achievement of their goals through their selection process and through their educational programming. As we discussed in the introduction, the goal of higher educational institutions, especially research universities, appears to emphasize the practice of critical thinking together with problem solving, analytical, evaluative skills, and reasoning skills. These described cognitive skills are conceptually, and largely, associated with the AC mode of learning; thus, freshman undergraduates as a whole in a research university will tend to prefer to learn through the AC learning mode.
Hypotheses

Our theoretical discussion concerning Kolb’s ELT enables us to generate the following 9 hypotheses about the relationship between learning styles and learning skills in higher education as shown in Figure 2 and to propose one hypothesis about the characteristic of learning preference of the undergraduate students.

Hypothesis 1-a
The more students prefer to learn through concrete experience rather than abstract conceptualization, the greater they will display a level of learning skill development in relationship skills, leadership skills, and the skills of helping and understanding people.

Hypothesis 1-b
The more students prefer to learn through concrete experience rather than abstract conceptualization, the smaller they will display a level of learning skill development in theory building skills, quantitative analysis skills, and technology management skills.

Hypothesis 2-a
The more students prefer to learn through abstract conceptualization rather than concrete experience, the greater they will display a level of learning skill development in theory building skills, quantitative analysis skills, and technology management skills.

Hypothesis 2-b
The more students prefer to learn through abstract conceptualization rather than concrete experience, the smaller they will display a level of learning skill development in relationship skills, leadership skills, and the skills of helping and understanding people.

Hypothesis 3-a
The more students prefer to learn through reflective observation rather than active experimentation, the greater they will display a level of learning skill development in sense-making skills, information gathering skills, and information analysis skills.

**Hypothesis 3-b**

The more students prefer to learn through reflective observation rather than active experimentation, the smaller they will display a level of learning skill development in goal setting skills, action skills, and initiative skills.

**Hypothesis 4-a**

The more students prefer to learn through active experimentation rather than reflective observation, the greater they will display a level of learning skill development in goal setting skills, action skills, and initiative skills.

**Hypothesis 4-b**

The more students prefer to learn through active experimentation rather than reflective observation, the smaller they will display a level of learning skill development in sense-making skills, information gathering skills, and information analysis skills.

**Hypothesis 5**

Undergraduate students at an entrance level of the research university will show a learning preference for abstract conceptualization.

**METHODS**

**Sample and Procedures**

This study was part of a two-year longitudinal research on the relationship between a learning environment and students’ learning, academic skill development, and
attitudes in a research university in the Mid-Western area. The initial sample consisted of 310 freshmen undergraduate students whose majors were diversified over 30 academic disciplines. From the sample of 310 students, 22 cases were eliminated because of missing data or a lack of consent form to participate in this research project; thus, 288 cases were finally usable for data analysis in our investigation.

For this research, we first sent out via campus mail a packet containing a cover letter, a set of questionnaires, and a consent form to participate in this research, to 881 undergraduate students who just entered the university as freshmen. Students who intended to participate in this research project were asked to return completed questionnaires with a signed consent form by campus mail or to drop them in a box at the beginning of their first fall semester.

Measures

The Learning Style Inventory (LSI) and the Learning Skill Profile (LSP) were employed in this study. These two instruments were invented and designed to be conceptually consistent with ELT (Boyatzis & Kolb, 1991, 1995, and 1997; Mainemelis el at, 2002). A difference in methodology between the LSI and the LSP also contributes to decrease problems of common method variance (Mainemelis el at, 2002).

The Learning Style Inventory

The Learning Style Inventory (LSI) is one of the most frequently used instruments to assess learning styles (Davies el at, 1997; West, R. F., 1982). This instrument examines differences in individual learning styles, using a forced-choice method by which to measure an individual learning orientation towards the four learning modes:
concrete experience (CE), abstract conceptualization (AC), reflective observation (RO), and active experimentation (AE). The LSI is composed of 12 questions, each of which asks someone to complete a sentence by ranking four choices that correspond to four learning modes encompassed by ELT. For example, the first question in the LSI is: “When I learn,” and the four choices to be ranked are: “I like to deal with my feelings; I like to think about ideas; I like to be doing things; and I like to watch and listen.” These four items reflect, in turn, the CE mode, the AC mode, the AE mode, and the RO mode of learning. The sum of a number ranked from ‘4 = you learn most’ to ‘1 = you learn least’ on each four modes represents the degree of how much a person relies on each of the four different modes of learning. The scores that are subtracted from one sum to the other in the same learning dimension: that is, the value of AC – CE or that of AE – RO, describe a relative preference of persons between its two dialectical modes.

The methodology adopted in the LSI with which to assess differences in individual learning styles relies on its forced-choice method that can not only reflect the dialectical nature of human learning activities (Kolb, 1984; Hickcox, 1991), but also serves to effectively control response sets regarding social desirability, acquiescence, and central tendency (Saville & Wilson, 1991). Veres, Sims, and Locklear (1991) reported the examination of the test-retest reliability of the LSI, showing its coefficients of the four learning modes reached 0.91 to 0.99.

The Learning Skill Profile

The Learning Skill Profile (LSP) is designed to assess the level of skill development in the aforementioned 12 learning skills using 72 items, each of which represents a specific skill or activity (Boyatzis & Kolb, 1991, 1995). Originally, this
instrument is a card-sort method by which persons are asked to categorize 72-item cards into seven groups that correspond to their skill level in a range from 1 to 7: 1 = no skill or experience in this area, 2 = now learning this skill or activity, 3 = can do this with some help or supervision, 4 = a competent performance in this area, 5 = an above average performer in this area, 6 = an outstanding performer in this area, and 7 = a leader or creator in this area. In order to simplify the process of responding to this instrument as well as to ease the data collection, we changed from this card-sort format to a conventional one. This revised method uses paper sheets describing 72 items with the blank box next to each skill statement. In place of sorting those cards, respondents are therefore asked to write the appropriate number from 1 to 7 in such a blank box. In addition to this format modification, we revised descriptions of 8 items to adequately fit them to undergraduates’ learning contexts specific for our research project. For example, the original statement showing ‘be aware of various issues in the company’ was replaced by the following description, ‘be aware of various issues in the university.’ Another example illustrates how the statement ‘being sensitive to values’ was changed to that of ‘being sensitive to the values of diverse cultures. These revisions to the LSP thereby result a more focused examination of undergraduates’ academic learning skills rather than that of adult learning skills in general.

The seventy-two items form 12 six-item scales that identify 12 learning skills such as: leadership skills, relationship skills, the skills of helping and understanding people, sense-making skills, information gathering skills, information analysis skills, theory building skills, quantitative analysis skills, technology management skills, goal setting skills, action skills, and initiative skills. Boyatzis and Kolb (1991) reported
internal reliability coefficients of the 12 six-item scales using Cronbach's alpha in the sample of N = 236, ranging from 0.62 to 0.92, with an average of 0.78. Almost consistent with their report of the internal reliability, Cronbach’s alpha in the sample of this study (N = 288) varied from 0.69 to 0.91 with a slight increase in its average of 0.80. The Cronbach's alpha showed leadership skills = 0.83; relationship skills = 0.79; the skills of helping and understanding people = 0.76; sense-making skills = 0.78; information gathering skills = 0.69; information analysis skills = 0.79; theory building skills = 0.82; quantitative analysis skills = 0.85; technology management skills = 0.91; goal setting skills = 0.75; action skills = 0.79; and initiative skills = 0.83. With the exception of information gathering skills = 0.69, the rest of learning skills exceeded the minimum standard of 0.70 suggested by Nunnally (1978).

The LSP and its earlier version, the Executive Skill Profile (Boyatzis & Kolb, 1995), have been used in several recent studies such as: educational program assessment (Boyatzis, Stubbs, & Taylor, 2002; Ballou, Bowers, Boyatzis, & Kolb, 1999); testing ELT (Mainemelis et al 2002); development needs evaluation (Rainey et al, 1993); physician career development (Smith, 1990); and professional identity and ability (Sharp, 1990).

Variables

Dependent variables of Hypothesis 1 to 4

There were the 12 dependent variables of learning skills that were measured by the LSP. The sum of the 6-item scale scores of each learning-skill area assessed the level of such learning-skill development as dependent variables, ranging from 6 as a minimum
with 42 as a maximum. A higher score of this sum shows a greater level of skill development, whereas a lower score indicates a smaller level of such skill development.

**Independent variables of Hypothesis 1 to 4**

Two independent variables involve our hypothesis testing directly. They consist of an algebraic combination of four fundamental variables that were computed by raw scores of a sum of each learning modes: CE, AC, RO, and AE in the LSI. One independent variable represents students’ preference for the AC or CE mode. This variable was evaluated by subtraction of the sum of CE scores from that of AC scores; that is, the value of AC – CE, as discussed in the previous section of the LSI. The greater the value of AC - CE is toward 36, the more preferable the AC mode is to the CE mode. In contrast, the smaller the value of AC - CE is toward -36, the more preferable the CE mode to the AC mode. Similarly, the other independent variable, which is students’ preference for the AE mode or RO mode, was measured by the value of AE – RO. The greater the value of AE - RO is toward 36, the more preferable is the AE mode to the RO mode. In contrast, a larger negative value for AE - RO suggests a preference for the RO mode rather than the AE learning mode.

**Dependent and independent variables of Hypothesis 5**

The dependent variable of Hypothesis 5 refers to learning styles shown as the value of AC – CE and that of AE – RO, while the independent variable refers to the freshman in a research university and the American normative population in the LSI. Smith and Kolb (1985) reported the mean score of AC – CE = 4.3 and that of AE – RO = 5.9 as the American normative LSI scores with diversified sample of 1,448. We will use these statistics to test Hypothesis 5.
RESULTS

The correlation matrix and descriptive statistics for all variables appear in Table 1 except the statistical data of the American normative population. All statistics are based on raw data prior to centering. Table 2 presents the results of the regression analysis used for tests of our hypotheses.

Insert Tables 1 & 2 about here

Hypothesis 1-a predicts that students will show a greater level of learning-skill development in relationship skills, leadership skills, and the skill of helping and understanding people under the condition that they exhibit their preference for the learning mode of concrete experience (CE) over that of abstract conceptualization (AC). As predicted, the relationship between each of these three interpersonal skills and AC – CE was negative and statistically significant. Such negative correlations indicate that scores of CE are larger than those of AC, reflecting a positive relationship between these skills and students' relative preference for the CE rather than the AC mode. Therefore, Hypothesis 1-a received support.

Hypothesis 1-b predicts that under this same condition students who prefer to learn using the mode of concrete experience (CE) rather than that of abstract conceptualization (AC), will show a smaller level of learning skill development in theory building skills, quantitative analysis skills, and technology management skills. Because the association between each of these three analytical skills and AC – CE were positive and statistically significant, Hypothesis 1-b received support.
Hypothesis 2-a states that if students prefer to learn through the AC mode rather than the CE mode, they will display a higher degree of skill development in the three analytical skills such as: theory building skills, quantitative analysis skills, and technology management skills. Furthermore, Hypothesis 2-b shows that the students with such a learning preference will indicate a lower degree of skill development in relationship skills, leadership skills, and the skill of helping and understanding people. Again, AC – CE exhibits a significant, positive association with the three analytical skills, whereas it is significantly, negatively correlated with the three interpersonal skills. Like Hypotheses 1-a and 1-b, Hypotheses 2-a and 2-b are supported.

Hypothesis 3-a predicts that students will show a greater level of skill development in three perceptual skills such as: in sense-making skills, information gathering skills, and information analysis skills, provided that they like to learn through the learning mode of reflective observation (RO) better than that of active experimentation (AE). The relationship between those skills and AE – RO was not significant; thus, Hypothesis 3 was rejected. Hypothesis 3-b states that the students with a learning preference for the RO mode over the AE mode will display a smaller level of skill development in three behavioral skills: goal setting skills, action skills, and initiative skills. AE – RO was significantly, positively related to goal settings skills and initiative skills but was not significantly associated with action skills. Therefore, Hypothesis 3-b was marginally supported.

Hypothesis 4-a predicts that the more students prefer the AE mode over the RO mode, the greater the level of their learning skill development is in three behavioral skills. Hypothesis 4-b states that students will show a smaller level of learning skill
development in three perceptual skills under the same condition that they prefer to learn through the AE mode over the RO mode. The independent variable of AE – RO describes a significant, positive correlation with goal setting skills and initiative skills but no significant relationship with action skills. Consequently, Hypothesis 4-a was partially supported. Because AE – RO is not significantly linked with three perceptual skills, Hypothesis 4-b was rejected.

Hypothesis 5 states that the freshman in a research university prefer to learn through abstract conceptualization (AC). Table 3 illustrates a result of one sample t-test with mean scores of our sample and those of the normative population presented by Smith and Kolb (1985). There is a statistically significant difference between the two groups in terms of both dialectical dimensions. The value of the AC – CE is far greater and the value of the AE – RO is smaller than that of the population respectively. This result provided support of Hypothesis 5.

Insert Table 3 about here

Figure 3 illustrates a change of betas as an indicator to what extent two independent variables of AC – CE and AE – RO had impact upon the 12 learning skills respectively. Two lines of AC – CE moved differently according to the 12 learning skills. The AC – CE was more varied and lay in a critical region (p<0.05) than the AE – RO. The AC – CE was significantly related to 9 learning skills: 4 skills were positively associated while 5 skills were a negatively associated. The AE –RO significantly, and
positively, affected 3 learning skills. As a consequence, it would be inferable that the AC – CE dimension has more influence over such learning skills than does the AE - RO.

Insert Figure 3 about here

DISCUSSION

Review of Results

Our study showed that learning styles encompassed within ELT affected the development of learning skills in higher education with regard to undergraduate students. In sum, students who have a learning preference for concrete experience (CE) showed enhancement of three interpersonal skills. Such a preference, however, showed a decrease in three analytical skills. The preference for the AC showed a positive development in three analytical skills, while it diminished the level of skill development in three interpersonal skills. Students who liked to learn through active experimentation (AE) rather reflective observation (RO) exhibited a higher level of development in goal setting and initiative skills but not in action skills. Students’ learning preference for the RO mode showed a smaller level of development in goal setting and initiative skills. The level of skill development in three perceptual learning skills was not significantly associated with students’ learning preference for the AE mode over the RO mode or vice versa.

Our findings enable us to conclude that a learning preference in the dialectical learning dimension of the AC and CE are associated with higher levels of skill
development in their concomitant learning skills. Another conclusion that can be drawn is that learning styles in the dialectical dimension of the AE and the RO modes are correlated with greater levels in two behavioral skill developments: goal setting skills and initiative skills, while such learning styles are not related to higher levels in action skills and in three perceptual skills. These results are mostly consistent with earlier research that supports relationships among ELT constructs.

In this study, the impact of the AE – RO on action skills was positive but relatively marginal ($\beta = 0.09, p<0.12$). This result might be the nature of our sample of undergraduates, who just entered a university. We used a 6-item action scale, some items of which are related to task orientated behavior in their learning context. The students’ task orientation may suggest that they are required to comply with disciplinary requirements, like ‘working to meet deadlines’ or ‘organizing day to day activities’, which constitute the 6-item action scale. According to the research of Loevinger, Wessler, and Redmore (1970), the majority of late adolescents and adults are placed at the stages of Conformist or Conscientious or squarely between them. This notion allows us to consider that the freshman sample may be sensitive to responses to external rules as a result of ego development. Therefore, some students with the AE learning mode are inherently active but may regard themselves as poor at ‘organizing day-to-day activities’, ‘working to meet time deadlines’, and so on. The current design of the action skill scale might not fit the context of our sample, because the current design fits better for a population of adults, such as the MBA student sample studied by Mainemelis et al. (2002). However, since this view tends to be impressionistic rather than scientific, a
thorough future investigation would be necessary with regard to contextual appropriateness of the scale.

As did the result of Mainemelis el at (2002), our result also showed that the AE – RO was not statistically associated with three perceptual learning skills, though their study made these three skills into one learning-skill cluster as a dependent variable. This consistent evidence might suggest an argument against the perspective that learning styles in the AE and RO dimension is associated with higher levels of skill development in three perceptual learning skills in the LSP. Because learning styles facilitate the development of a general class of specific learning skills (Kolb, 1984), it may be necessary to examine to what extent these three specific skills are structurally reflected into the generic learning mode of RO. This examination in future research will provide useful information to help us understand not only the structure and contents in the LSP but also the relationship between learning styles and learning skills.

With regard to the result of the characteristics of freshmen’s learning style in higher education, our study confirmed that entrance level undergraduate students tend to learn from the AC and the RO mode rather than from the CE and the AE mode: the value of AC – CE = 9.7 and that of AE – RO = 3.1. This result showed a strong tendency toward abstraction (AC). The study conducted by Ruble (see Yuen and Lee, 1994) did show a similar result with 310 undergraduate students of various majors who were oriented toward the Assimilating learning style: the value of AC – CE = 6.6 and that of AE – RO = 2.2. Although our freshman sample displayed greater values on both learning dimensions compared with Ruble’s research, the typical learning preference of undergraduates in general may be the Assimilating style. As a consequence, the
accentuation of this style leads to the development of its concomitant learning skills: especially, those skills relevant to the AC mode of learning, such as analytical reasoning and critical thinking. The institutional emphases of critical thinking, which is a primary purpose in higher education, as well as that of basic cognitive skills (i.e. reading, writing, etc.) are providing the environmental characteristics sought by the dominant learning style of abstract conceptualization. The environment then further supports the development of the Assimilating learning style. To test this assumption, a wider empirical investigation will be needed.

Implications for Higher Education

Our study showed that the dominant learning style of freshmen in a research university is likely to be the AC mode which requires individuals to use logical thinking and analytical abilities. Our result suggests that higher educational institutions also tend to select students who fit their goals and characteristics, which at present are oriented towards the development of such logical thinking and analytical reasoning skills. For example, through their selection process norms, a standard test such as SAT for entrance to undergraduate and GRE or GMAT for that of graduate students is presently used to examine and identify students' fundamental abilities. If higher educational institutions only seek to develop particular cognitive skills such as analytical reasoning and thinking, the current selection process is an appropriate tool with which to screen the candidates. However, if the students are to develop different types of institutional goals such as the acquisition of interpersonal skills, leadership skills, initiative skills, and so on, the current selection process strategy may not be adequate to meet that goal; instead it may generate
further difficulty in achieving such a goal, unless the educational institutions tailor their programs to meet those differing needs. Such a selection strategy, which depends significantly upon using a single, standardized test as a reliable instrument to screen students, can evaluate only limited aspects of the whole picture of student candidates. Higher education institutions are thus challenged to establish different, more integrated methods for their selection process, which include an evaluation of the students' attributes overall.

With regard to the first implication, higher education, as discussed in this study, at present aims at developing students' cognitive skills such as critical thinking, analytical capabilities, logical reasoning, and others. However, the cognitive development is not the only desired outcome from a university or college experience. The National Postsecondary Education Cooperative, when focusing on learning-skill development, lists also the psychosocial development including interpersonal skills, and workplace skills such as: adaptability, initiative, leadership, ability to work independently/in group, etc. Higher educational institutions recognize those learning skills as highly valuable for undergraduate students. But such learning skills entail the CE and the AE learning modes, which are dialectically in opposition to the AC and the RO modes. Our finding illustrates that the typical learning style of undergraduates tends to be the Assimilating learning style, which is completely opposite to the Accommodating style reflected by the CE and the AE modes. Considering this, we raise the question what educational programs or curriculum in higher education would effectively facilitate the development of the CE and the AE modes of learning and, thus, their concomitant learning skills. What would an integrative educational program be in order to develop those modes
without hindering the development of the AC and the RO modes? At an individual student level, through what kind of effective pedagogical initiatives could their learning styles and learning skills be changed or developed toward the Accommodating learning style? Furthermore, how would an innovative learning environment affect students’ overall satisfaction? Exploration of these inquiries may provide new insights into the pursuit of creating better learning environments in higher education.

CONCLUSION

Understanding learning styles is essential for learning enhancement in higher education (Sims & Sims, 1995). Under this premise, we examined the impact of learning styles upon the development of learning skills in higher education using Kolb’s ELT. The result of our study was mostly in congruence with that of the previous research. Furthermore, we compared undergraduates’ learning styles with those of the normative population of the LSI, showing that undergraduate learning styles tend to be oriented towards the Assimilating learning style. We discussed implications for higher education and possible future research resulting from our study. It is our hope that this study will contribute towards making it a continual endeavor to search for better pedagogical environments in higher education from a standpoint of understanding the relationship between learning styles and learning skills.
REFERENCES


### TABLE 1
Descriptive Statistics and Correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 AC</td>
<td>23.81</td>
<td>6.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 RO</td>
<td>33.40</td>
<td>6.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 GB</td>
<td>26.82</td>
<td>6.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 AB</td>
<td>32.89</td>
<td>6.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 AC-GB</td>
<td>9.08</td>
<td>10.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 AB-RO</td>
<td>3.07</td>
<td>10.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Leadership</td>
<td>27.03</td>
<td>6.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Relationship</td>
<td>3.08</td>
<td>1.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Help &amp; understanding</td>
<td>28.81</td>
<td>5.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Sense-making</td>
<td>27.32</td>
<td>4.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Information gathering</td>
<td>25.01</td>
<td>5.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Information analysis</td>
<td>26.53</td>
<td>4.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Theory building</td>
<td>26.29</td>
<td>5.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Quantitative analysis</td>
<td>26.64</td>
<td>5.43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Technology &amp; computer</td>
<td>23.33</td>
<td>7.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Goal setting</td>
<td>28.31</td>
<td>4.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Action</td>
<td>28.64</td>
<td>5.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Initiative</td>
<td>28.38</td>
<td>5.35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = 288
*p < .05
**p < .01
***p < .001

### TABLE 2
Results of Regression Analysis

<table>
<thead>
<tr>
<th></th>
<th>Interpersonal learning skills (CE)</th>
<th>Perceptual learning skills (RO)</th>
<th>Analytical learning skills (AC)</th>
<th>Behavioral learning skills (AE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Leadership</td>
<td>Help &amp; understanding</td>
<td>Sense making</td>
<td>Information gathering</td>
</tr>
<tr>
<td>β</td>
<td>R²</td>
<td>β</td>
<td>R²</td>
<td>β</td>
</tr>
<tr>
<td>AC-CE</td>
<td>-.14*</td>
<td>.06</td>
<td>-.22***</td>
<td>.06</td>
</tr>
<tr>
<td>AE-RO</td>
<td>.19***</td>
<td>.08</td>
<td>.07</td>
<td>.10</td>
</tr>
<tr>
<td>F</td>
<td>8.27***</td>
<td>8.20***</td>
<td>9.54***</td>
<td>1.92</td>
</tr>
</tbody>
</table>

N = 288
*p < .05
**p < .01
***p < .001

Learning styles and learning skills 34
<table>
<thead>
<tr>
<th>Variables</th>
<th>t</th>
<th>df</th>
<th>Mean difference</th>
<th>Test value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-CE</td>
<td>8.37***</td>
<td>287</td>
<td>5.38</td>
<td>4.3</td>
</tr>
<tr>
<td>AE-RO</td>
<td>-4.37***</td>
<td>287</td>
<td>-2.83</td>
<td>5.9</td>
</tr>
</tbody>
</table>

*American normative population reported by Smith and Kolb (1985)
N = 288
*** p < .001 (2 tailed)
FIGURE 3

Impact of Two Dialectical Learning Dimensions on 12 Learning Skills: Change of Beta

- AC - CE
- AE - RO