Relationships among self-directed learning, learning styles, learning strategies and learning achievement for students of Technology University in Taiwan by using structural equation models

MEI-CHING CHEN
Department of Insurance
Chaoyang University of Technology
168, GiFeng E. Rd., WuFeng, Taichung City, 413 Taiwan, R.O.C.
TAIWAN
mcchen@mail.cyut.edu.tw

Abstract: - This paper aimed to investigate the relationships among self-directed learning, learning styles, learning strategies, and learning achievement in English courses by insurance finance students at a Science and Technology University in Taiwan. We used the questionnaire survey in this research. Then, we verified the research model and hypotheses using structural equation modeling analysis. The underlying concepts of self-directed learning are becoming increasingly important as the need for educators continues to grow. Educators are challenged to learn more about self-directed learning skills and to encourage students to use self-direction in their learning activities more often. Although self-directed learning became a great concern in the field of education, it still remains an unsettled question. The present results revealed that self-directed learning had no significant effect on the learning strategies and learning achievement. Learning styles affected learning strategies. Contrary to expectation, learning styles had no direct influence on learning achievement. Learning strategies also had no impact on learning achievement. Secondly, we examined the mediating effect of the learning strategies between self-directed learning and learning achievement; we found it was not supported, and learning strategies also did not mediate the effect of learning styles on learning achievement. Based on a discussion on the results of this research, we expect to provide the key factors affecting the effectiveness of learning a second language. In addition, we hope to offer further understanding and contribute to the learning achievement in English courses.

Key-Words: - Self-directed learning, Learning styles, Learning strategies, Learning achievement, Structural equation modeling (SEM)

1 Introduction

A second language is a language studied in a setting where that language is the main vehicle of everyday communication [17]. In today’s world, English has become the international language. So studying English courses is part of the basic university education in Taiwan; however, most Taiwanese students lack self-directed learning motivation, which leads to poor learning effects/achievement. Oxford (1999) also points out that language learning styles and strategies are among the main factors that help to determine how and how well students learn a second or foreign language [17]. Therefore, exploring the factors affecting learning achievement to determine how to improve students’ self-directed learning motivation is important for educators.

Self-directed learning has always played a critical role, even with the rapid evolution of adult learning theory. Self-directed learning means that individuals select, manage and assess their own learning activities, which can be pursued at any time, in any place, through any means, and at any age. Lamdin and Fugate (1997) describe self-directed learning: “The important thing is that these projects are ‘owned’ by the learner who is in control of what is learned, when the learning starts, where it goes, and when it is complete” [14]. Merriam and Caffarella (1999) also define self-directed learning as a process “in which people take the primary initiative for planning, carrying out and evaluating their own learning experiences” [16]. Guglielmino's Self-Directed Learning Readiness Scale (SDLRS) is one of the most widely used instruments designed to
measure self-directed learning readiness [10]. Reid (1995) defines learning style as an individual’s natural, habitual and preferred ways of absorbing, processing, and retaining new information and skills [19]. Scarcella and Oxford (1992) define learning strategies as “specific actions, behaviors, steps, or techniques such as seeking out conversation partners, or giving oneself encouragement to tackle a difficult language task used by students to enhance their own learning” [20].

With the abovementioned research background and motives in mind, this present article focuses on a Taiwan university of science and technology’s English courses. The two purposes of the present article are: (1) to use a questionnaire survey to explore the factors affecting learning achievement in English courses taken by insurance finance students of a Science and Technology University in Taiwan; (2) to perform the statistical analysis based on the structural modeling analysis for estimating the relationships among self-directed learning, learning styles, learning strategies, and learning achievement.

2 Literature and hypotheses

2.1 The choice of explanatory variables

The concepts underlying self-directed learning are becoming increasingly important as the need for educators grows. Educators are challenged to learn more about self-directed learning skills and to encourage students to use self-direction more often in their learning activities. Guglielmino's Self-Directed Learning Readiness Scale has been widely used for measuring self-directed learning [10]. Long and Agyekum (1983) also designed a multitrait-multimethod procedure for determining the validity of the Self-Directed Learning Readiness Scale; they tested thirty-seven specific hypotheses and the findings of the validity of the Self-Directed Learning Readiness Scale are supportive [15]. According to Grow (1991), good teaching matches the learner's stage of self-direction and helps the learner advance towards greater self-direction [9]. Reid (1987) proposed six styles of learning as research variables: visual style, auditory style, kinesthetic style, tactile style, group style and individual style [18]. Oxford (1999) assumed that learning strategies can be classified into six groups: cognitive, meta-cognitive, memory, compensatory, affective, and social [17]. In regard to the acquisition of a second language, many researches point out that self-directed learning, learning styles and learning strategies are the factors affecting learning achievement [4, 5, 7]. The latent variables can be summarized as follows:

- Self-directed learning is the composite index of the love of learning, effective learning, active learning, independent learning, creative learning and learning motivation. It is expected that self-directed learning has a positive effect on the learning achievement in English courses for insurance finance students of a Science and Technology University.
- Learning styles are the composite index reflecting the styles of visual, auditory, kinesthetic, tactile, group, and individual. It is expected that learning styles have a positive effect on the learning achievement in English courses for insurance finance students at a Science and Technology University.
- Learning strategies are the composite index of memory strategy, cognitive strategy, compensation strategy, meta-cognitive strategy, affective strategy, and social strategy. It is expected that learning strategies have a positive effect on the learning achievement in English courses for insurance finance group students in a Science and Technology University. We also posited that learning strategies will mediate the effects of self-directed learning and learning styles on learning achievement.

2.2 Development of hypothesis

After reviewing the studies by exploring the causal and mediating relations, we propose a set of research hypotheses, presented below.

\( H_1 \): Self-directed learning has an effect on learning strategies.

\( H_2 \): Self-directed learning has an effect on learning achievement.

\( H_3 \): Learning styles have an effect on learning strategies.

\( H_4 \): Learning styles have an effect on learning achievement.

\( H_5 \): Learning strategies have an effect on learning achievement.

\( H_6 \): Learning strategies will mediate the effect of self-directed learning on learning achievement.

\( H_7 \): Learning strategies will mediate the effect of learning strategies on learning achievement.
3 Research methodology

The proposed model and hypothesis were estimated by structural equation modeling (SEM), which is a powerful multivariate technique for analyzing causal models. A structural equation model is composed of a measurement model and a structural model. The measurement model is estimated using confirmatory factor analysis (CFA) to test whether the latent variables possess sufficient construct validity. The structural model is used to present the relations of causal effects among the latent variables [12]. The entire data analysis was completed with Amos 7.0 for windows. Parameter estimation was performed by maximum likelihood estimation. Then the data analysis proceeded with the two-step approach of the structural equation modeling. In this study, the learning strategies and learning achievement in English courses taken by insurance finance students are the endogenous variables. The exogenous latent variables include self-directed learning and learning styles.

3.1 Sample description

In order to develop the questionnaire survey instrument, a pool of items was identified from the literature review, for measuring the constructs of the research model. Data from the questionnaire survey sample were used to evaluate the instrument’s validity and reliability, as well as to test the hypothesized causal and mediating relationships of the research model. Data for the exploratory study were gathered through a questionnaire survey. A pre-test of the questionnaire was performed with the help of several education specialists. The respondents were asked to complete the questionnaire and provide comments on the wording, understandability and clarity of list items that correspond to the constructs. Finally, we used the pilot test to evaluate the internal consistency reliability, and revised all of the survey items. Each item was measured on a five-point Likert scale, ranging from extremely important (=5) to extremely unimportant (=1). We chose thirty college students to complete the questionnaires. The reliability must be greater than 0.6 in a general study. In this research, we used Cuieford’s (1965) suggestion that the Cronbach’s α value satisfying 0.7 shows high reliability [6]. The results of the Cronbach’s α values are higher than 0.7 in all items, showing that the reliability is good in this research. After the pre-test and pilot-test, the instrument was deemed ready to be sent to a large sample in order to gather data for testing our research model. The target subjects were insurance finance students of a Science and Technology University in Taiwan. The 330 sample questionnaires were sent to the students in class. The survey questionnaires were gathered from the 1st to the 7th of March 2007. The total number of returned research surveys was 330; 37 invalid responses were deleted, for an effective response rate of 88.78% (totaling 293) retained for analysis.

3.2 Reliability

To examine the internal consistency reliability of the observed items questionnaire, we assessed Cronbach’s alpha using SPSS 15.0 statistic software. The resulting alpha values ranged from 0.812 to 0.904, which were above the acceptable threshold, as shown in Table 1.

3.3 Assessment of the measurement model

We assessed the measurement model by confirmatory factor analysis (CFA). Segars and Grover [22] suggest that the measurement model should be evaluated first and then the best overall model fit can be generated. The measurement model was assessed to ascertain the extent to which the observed measures accurately estimate their corresponding construct. There are many aspects of construct validity that have been proposed in the literature [8, 11, 12, 24]; herein, convergent validity was estimated by examining the factor loading, composite reliability and average variance extracted [12]. We used confirmatory factor analysis (CFA) with AMOS 7.0 to examine the convergent validity of each construct. The factor loadings that are smaller than the recommended level of 0.5 should be removed [11]. Therefore, 15 items were retained after finishing the research, as shown in Table 1. Fornell and Larcker (1981) suggest that the recommended threshold of average variance extracted is 0.5, while Hair et al. (1998) suggest that the recommended threshold of composite reliability should be greater than 0.7. All composite reliabilities measures of constructs exceed the recommended threshold of 0.7. Discriminant validity can be tested by comparing the square roots of the AVE with the correlations among the constructs [12]. All of the square roots of the AVE by constructs were greater than the correlation among constructs as shown in Table 2, so discriminant validity was supported. In brief, the measurement model assessment, including
convergent and discriminate validity measures, was satisfactory.

Table 1: Estimates of the measurement model

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Factor Loading</th>
<th>Cronbach’s α</th>
<th>CR</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-directed Learning</td>
<td>Love of Learning</td>
<td>0.641***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Effective Learning</td>
<td>0.595***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Independent learning</td>
<td>0.679***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Creative Learning</td>
<td>0.725***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Learning Motivation</td>
<td>0.874***</td>
<td>0.833</td>
<td>0.833</td>
<td>0.503</td>
</tr>
<tr>
<td>Learning Styles</td>
<td>Auditory Style</td>
<td>0.558***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kinesthetic Style</td>
<td>0.862***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tactile Style</td>
<td>0.889***</td>
<td>0.812</td>
<td>0.816</td>
<td>0.539</td>
</tr>
<tr>
<td></td>
<td>Group Style</td>
<td>0.540***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Strategies</td>
<td>Memory Strategy</td>
<td>0.760***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cognitive Strategy</td>
<td>0.881***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compensation Strategy</td>
<td>0.730***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meta-cognitive Strategy</td>
<td>0.889***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Affective Strategy</td>
<td>0.803***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social Strategy</td>
<td>0.796***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** denotes significance at \( p<0.001 \).

Table 2: Discriminant validity

<table>
<thead>
<tr>
<th>Construct</th>
<th>Self-directed Learning</th>
<th>Learning Styles</th>
<th>Learning Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-directed Learning</td>
<td>0.709</td>
<td>-0.001</td>
<td>0.534</td>
</tr>
<tr>
<td>Learning Styles</td>
<td>-0.044</td>
<td>0.734</td>
<td>0.812</td>
</tr>
<tr>
<td>Learning Strategies</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The overall model fit was assessed in terms of eight measures. These indices included: the chi-square/degree of freedom (\( \chi^2 / \text{d.f.} \)), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), normalized fit index (NFI), non-normalized fit index (NNFI), incremental fit index (IFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA) [1]. Hayduk (1987) suggests that \( \chi^2 / \text{d.f.} \) should not exceed 3 [13]. Scott (1995) considers that GFI should be greater than the recommended value of 0.9 and AGFI should be above the recommended threshold of 0.8 [21]. Bentler and Bonett (1980) further suggest that NFI, NNFI and CFI should exceed 0.9 [1, 3]. Accordingly, all the fitness measures in this research fell into acceptable ranges using CFA. Consequently, the proposed model provided a suitable fit.

3.4 Assessment of the structural model

We estimated the proposed model by using structural equation modeling with the maximum likelihood estimation method. The structural model reflecting the causal relationships among the latent constructs was estimated with the data collected from the validated measures. The model fit indices were within accepted thresholds: \( \chi^2 = 150.53, \ p=0.000, \chi^2 / \text{d.f.} = 1.552, \text{GFI}=0.941, \text{AGFI}=0.918, \text{NFI}=0.94, \text{NNFI}=0.972, \text{CFI}=0.978, \text{RMSEA}=0.042. \) Accordingly, the recommended thresholds and results of the estimation of structural model fitness indicate a good model fit. Based on the good fit of the structural model, the path coefficients of the structural model were then estimated. Fig. 1 shows the results of path coefficients and hypotheses tests.
3.5 Empirical findings

According to the results, self-directed learning had no significant effect on the learning strategies and learning achievement ($\gamma = -0.054$, $p = 0.328$; $\gamma = -0.076$, $p = 0.229$), hypotheses 1 and 2 were not supported. Learning styles had direct influence on the learning strategies ($\gamma = 0.606$, $p < 0.001$), supporting hypothesis 3. Contrary to expectation, learning styles had no direct influence on the learning achievement ($\gamma = -0.076$, $p = 0.371$), so hypothesis 4 was not supported. Learning strategies had no significant effect on the learning achievement ($\beta = 0.04$, $p = 0.617$), so hypothesis 5 was not supported. It accounted for 37.1% of the variance in learning strategies. Hypotheses 6 and 7 posited that learning strategies would mediate the influences of self-directed learning on the learning achievement and learning strategies on the learning achievement. To test these hypotheses, we followed the Sobel test equation [2, 23]. The Sobel test statistic showed that learning strategies were not a significant mediator of relationship between self-directed learning and learning achievement, and also that learning strategies did not mediate the effect of learning styles on learning achievement: ($Z = -0.444$, $p = 0.657$; $Z = 0.499$, $p = 0.618$), so hypotheses 6 and 7 were not supported.

4 Conclusions

Our study presented and validated a multi-facet model to help in understanding the factors contributing to learning achievement in English courses. According to the results of the present study, learning styles affected learning strategies. Contrary to expectation, self-directed learning had no significant effect on learning strategies and learning achievement, learning styles had no direct influence on learning achievement, and learning strategies also had no impacts on learning achievement. Secondly, we examined the mediating effect of the learning strategies between self-directed learning; learning

Fig. 1: Results of structural modeling analysis
achievement was not supported, and learning strategies also did not mediate the effect of learning styles on learning achievement. Some limitations of this study are that the results may have been impacted by self-selection biases, and this research was focused on the learning achievement in Taiwan, as opposed to being a global survey; thus, the results can not completely reflect the conditions globally. Finally, this research only has three factors to test and verify the learning achievement in English courses. We hope to discover more factors in the future to make the research model more complete.

References: