A Study of Personality, Motivation and Chemistry Academic Achievement

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Abstract

The purpose of the research was to investigate whether personality and motivation of junior college students were related to chemistry academic achievement. Participants were 350 junior college students. After screening the returned questionnaires and eliminating invalid responses, there were usable 326 valid questionnaires. They filled in the questionnaires of personality traits (i.e. NEO-FFI) and the Motivation Questionnaire (i.e. Patterns of Adaptive Learning Survey). In terms of the relationship between personality and academic achievement, results showed that positive and significant relationship between chemistry academic achievement and extraversion personality trait. Also, chemistry academic achievement and overall motivation have positive and significant relationship. In terms of the relationship between each construct of personality and motivation, we found that Neuroticism and Extraversion were negatively related with achievement goal and learning environment stimulation. Conscientiousness was also negatively related with achievement goal. Openness and Agreeableness do not have any significant relation with each construct of motivation.

Key words: Personality; learning motivation; Chemistry academic achievement

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1. Introduction

Previous studies in science education showed that lots of students at all levels struggle to learn chemistry, but are often unsuccessful (e.g. Bodner, 1991; Herron, 1975; Nakhleh, 1992; Sawrey, 1990). Therefore, many chemistry educations have discussed this issue and provided possible explanations from cognition-oriented models like Constructivism (Bodner, 1986) and Piaget’s theory of intellectual development (Herron, 1978). In spite of the effort put in explaining learners’ failure in learning Chemistry, some scholars (Borg & Shapiro, 1996; Ward & Bodner, 1993; Ziegert, 2000) suggested that the root of the problem and some possible but neglected perspective of learning chemistry might be related to learners’ motivation (Ward & Bodner, 1993) and their personality types (Borg & Shapiro, 1996; Busato, Prins, Elshout, & Hamaker, 2000; Ziegert, 2000). These findings suggested that research may be complemented by considering the role an individual's personality and motivation may play in the learning process. In order to fill in the research gap, the researchers investigated the relationships among junior college students’ personality traits, learning motivation, and Chemistry academic achievement so as to propose an alternative complementary view on the possible roots of this problem.

2. Literature Review

2.1 Big Five Personality Traits

A person’s values and preferences were often reflected in their personality traits, which can explain the occurrences of certain individual behaviors and were regarded as an individual's disposition to particular patterns, or as enduring dispositions that caused characteristic patterns of interaction with one’s environment (Goldberg, 1993; Olver & Mooradian, 2003).

Previous studies have led to the development and categorization of categorizing personality traits into five factors (Borkenau & Liebler, 1992; Buss, 1991; Cattel, 1946; Digman, 1990; Funder & Sneed, 1993; Goldberg, 1992, 1993; McCrae & Costa, 1987, 1997; Norman, 1963; Sneed, 2002; Sneed, McCrae, & Funder, 1997). Among them, NEO-FFI, developed by Costa and McCrae (1986), was the most widely used measure of personality traits, and has emerged as a popular model for understanding the relationship between personality and various academic behaviors. This inventory has been proved to reliably assess the five personality dimensions in numerous studies and has demonstrated good internal and external validity (Saucier, 1994; Sneed, 2002).
The Five-Factor Model (also known as the Big Five) includes Conscientiousness, Neuroticism, Extraversion, Agreeableness and Openness to Experience (Costa & McCrae, 1992; Digman, 1990; Digman & Takemoto-Chock, 1981; Goldberg, 1990, 1993; McCrae, 1992; Norman, 1963). Neuroticism is the tendency to experience a heightened sensitivity to negative stimuli and negative emotionality, such as worry and anxiety. Extraversion is the tendency for being concerned with or responsive to things external to oneself and to engage in social activities. Agreeableness is the tendency to be pleasant and accommodating in social situations as well as a general orientation towards experiencing empathy, warmth, and generosity toward others. Openness is the tendency toward being imaginative, open to new experiences, and having a broad range of interests (Goldberg, 1992; Mount & Barrick, 2002).

2.2 Learning Motivation

In addition to personalities, learning motivation can also be an important factor affecting learners’ academic performance. Motivation is generally defined as “the process whereby goal-directed activity is instigated and sustained” (Pintrich & Schunk, 1996, p.5), and has been one of the most developed and researched topics in the social science domain.

Kanfer, Ackerman and Heggestad (1996) described motivation as the direction of attentional effort, the proportion of total attentional effort directed to the task and the extent to which attentional effort toward the task is maintained over time. Motivation has been viewed as a critical factor affecting learning in the field of education (Lim, 2004). Mitchell (1997) described motivation as mental processes involving “encouragement, direction, passion, and persistence of voluntary actions that are goal directed” (p. 60). Therefore, motivation relates to what we choose to pursue (arousal and direction) and how we pursue it (intensity and persistence). These two broader categories have alternately been termed “goal setting and goal striving, “choice motivation and control motivation, “goal selection and goal application, “and “goal choice and self- regulation” (Mitchell, 1997).

Motivation is also defined as the extent to which the individual works or strives to learn the language because of a desire to learn the language and the satisfaction experienced in this activity. Therefore, Gardner (1985) stated a motivated learner is defined as one, who is eager to learn the language, willing to expend effort on the learning activity, and willing to sustain the learning activity.

Researchers (Gan, 2003; Oxford & Nyikons, 1989; Yang, 1999) found the cyclical
relationships among beliefs, motivations and learning behaviors. These studies indicated “strong motivation, positive attitudes and effective learning effort may result in increased language attainment and a feeling of progress, which may in turn enhance motivation and facilitate further effort” (Gan, 2003, p.73).

2.3. Personality and Academic Achievement

Personality traits influence academic achievement. For instance, conscientiousness has a consistently positive association with high school GPA (Conard, 2006; Noftle & Robins, 2007). Both openness and agreeableness are positively related to academic performance (Lounsbury et al., 2003; Farsides & Woodfield, 2003), and neuroticism is associated with impaired academic performance (Furnham & Mitchell, 1991; Heaven et al., 2002). Noftle and Robins (2007) also reported that conscientiousness is the strongest predictor of academic performance, and the other four traits have weak or mixed relationships with GPA. Although these findings confirm the significance of personality traits, there remains a need to examine other individual level factors such as students’ motivation.

2.4 Motivation and Academic Achievement

In the past decades because of the effect of motivation for academic achievement on students’ success, psychologists have recognized and examined the effective factors in motivation for academic achievement. The results of their research indicated that personality, family, university and social variables are related to this construct (Maslin, 2007). As an instance personality variables of students in general and self-esteem and motivation for academic achievement in particular have intrinsically affected the learning and academic achievement (Abouserie, 2009). Others directed their studies towards integrating intellectual ability, learning style, personality and motivation for academic achievement as the predictors of academic achievement in higher education (Busato, Prins, Elshout & Hamaker, 1999).

2.5 The Current study

Prior research has established that both personality traits and motivation are associated with academic achievement respectively. However, not much is known about the joint influence of personality traits and motivation on learners’ Chemistry academic achievement. In the current
study, we sought to fill in this gap in the literature by directly examining the relationship between personality, motivation and academic achievement. Specifically, the research questions were as follows:

1. What is the relationship between junior college students’ personality and their Chemistry academic achievement?
2. What is the relationship between junior college students’ motivation and their Chemistry academic achievement?
3. What is the relationship between junior college students’ personality and their motivation?

3. Methodology

3.1 Participants

As a preliminary study, participants were recruited by means of convenience sampling over a month period in early October 2010. A total of 350 junior college students enrolled in six classes at one junior college in central Taiwan were recruited for participation in the study. After screening the returned questionnaires and eliminating invalid responses, there were usable 326 valid questionnaires. Twenty (6%) of the participating students were male and 306 (94%) were female. The average age of the participants was 15. All of the students in the sample majored in nursing. Information collected from the surveys was entered into the data sheet of SPSS 17 for further analysis.

3.2 Instruments

The English version for both questionnaires were used in the study. The NEO five factor Inventory (NEO-FFI) is a shortened (60 items) version, 5-factor measure of personality. It correlates with the NEO PI-R domain scales at .77-.92 and has a .68-.86 internal consistency values (Costa & McCrae, 1992). It consists of 60 items designed to assess the Big Five personality traits. It is the most widely used measure of personality traits with sound psychometric properties established by previous researchers (Costa & McCrae, 1992). The cronbach alpha values for each subscale’s internal consistency were as followed: .80 (neuroticism), .73 (extraversion), .68 (openness), .74 (agreeableness), 76 (conscientiousness). Participants indicated their degree of agreement with each statement using a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6).

The 35-item motivation questionnaire is based on the Patterns of Adaptive Learning Survey (PALS) by Midgley, Maehr and Urdan (1993). It is widely used measure of motivation with sound
psychometric properties established by previous researchers. It included six constructs: self-efficacy (7 items), active learning strategy (8 items); science learning value (5 items), performance goal (4 items), achievement goal (5 items), and learning environment stimulation (6 items). The Cronbach alpha values for each subscale’s were between .67 to .87. Participants indicated their degree of agreement with each statement using a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6). Students’ chemistry academic achievements were their grades obtained from the school records in the first semester of 2010.

3.3 Procedures

In this study, the data was collected during the fall 2010. Students were then informed about the general nature of the study one week prior to data collection. All students attending class on the day of data collection completed the questionnaires. The English version for both questionnaires was used in the study. All measures were completed in their classes under the supervision of their classroom teachers during an ordinary school lesson. Also, the instructor provided necessary assistance when the explanation of the items in both questionnaires was needed.

3.4 Data analysis

In terms of data analysis, means, standard deviations, and score ranges were computed and examined. Next, Pearson correlation analyses were employed to obtain a statistical estimate of the strength of the relationships between variables. As a rule of thumb, correlations were less than 0.3 were deemed low or weak. Those in the range of 0.4 to 0.6 were moderate, and those were greater than 0.7 as being strong or high (Bryman & Cramer, 2004). Third, the data were subjected to an ANOVA to determine if there was a difference in the results. In the presence of a significant difference, multiple comparisons were performed using the procedure as $\alpha=0.05$ significant level.

4. Results

RQ1: What is the relationship between junior college students’ personality and their Chemistry academic achievement?

Person correlation coefficients were computed to assess the relationship between the five constructs of personality and their academic achievement. The correlation coefficients indicate that there is positive and significant relationship between chemistry academic achievement and
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extraversion ($p<.05$).

Table 1 Statistics of Chemistry Academic Achievement and Each Construct of Personality

<table>
<thead>
<tr>
<th></th>
<th>mean</th>
<th>SD</th>
<th>number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>70.51</td>
<td>11.37</td>
<td>326</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>41.89</td>
<td>9.31</td>
<td>326</td>
</tr>
<tr>
<td>Extraversion</td>
<td>42.06</td>
<td>8.73</td>
<td>326</td>
</tr>
<tr>
<td>Openness to experience</td>
<td>42.27</td>
<td>7.73</td>
<td>326</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>42.23</td>
<td>4.93</td>
<td>326</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>41.77</td>
<td>8.29</td>
<td>326</td>
</tr>
</tbody>
</table>

Table 2 Correlations between Personality and Chemistry Academic Achievement

<table>
<thead>
<tr>
<th></th>
<th>Chemistry</th>
<th>Neuroeticism</th>
<th>Extraversion</th>
<th>Openness</th>
<th>Agreeableness</th>
<th>Conscientiousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>1</td>
<td>-.107</td>
<td>.109</td>
<td>.008</td>
<td>.065</td>
<td>.057</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-.107</td>
<td>1</td>
<td>.125*</td>
<td>.190**</td>
<td>.396**</td>
<td>.079</td>
</tr>
<tr>
<td>Extraversion</td>
<td>.109*</td>
<td>.125*</td>
<td>1</td>
<td>.473**</td>
<td>.295**</td>
<td>.778**</td>
</tr>
<tr>
<td>Openness</td>
<td>.008</td>
<td>.190**</td>
<td>.473**</td>
<td>1</td>
<td>.305**</td>
<td>.505**</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>.065</td>
<td>.396**</td>
<td>.295**</td>
<td>.305**</td>
<td>1</td>
<td>.325**</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>.057</td>
<td>.079</td>
<td>.778**</td>
<td>.505**</td>
<td>.325**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: *$p<.05$ ** $p<.01$, two tailed.

RQ2: What is the relationship between junior college students’ motivation and their Chemistry academic achievement?

Firstly of all, Person correlation coefficients were computed to assess the relationship between motivation and their academic achievement. The Pearson correlation coefficients indicate that there is positive and significant relationship between chemistry academic achievement and overall motivation ($r = .196$, $p < .01$).

Table 3 Descriptive Statistics of Chemistry Academic Achievement and Motivation

<table>
<thead>
<tr>
<th></th>
<th>mean</th>
<th>SD</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>70.51</td>
<td>11.37</td>
<td>326</td>
</tr>
<tr>
<td>Motivation</td>
<td>115.25</td>
<td>13.01</td>
<td>326</td>
</tr>
</tbody>
</table>

Follow-up analyses (see Table 4) were computed to assess the relationship between the six constructs of motivation and their academic achievement. Specifically, academic achievement was positively related with active learning strategy ($r = .189$, $p < .05$), science learning value ($r = .184$, $p < .05$), achievement goal ($r = .2$, $p < .05$), and learning environment stimulation ($r = .251$, $p < .05$).
However, academic achievement was negatively related with self-efficacy ($r=-.256$, $p<.05$)

Table 4: Correlations between Motivation and Chemistry Academic Achievement

<table>
<thead>
<tr>
<th></th>
<th>Chemistry efficacy</th>
<th>strategy</th>
<th>value</th>
<th>Performance</th>
<th>Achievement</th>
<th>Stimulation</th>
</tr>
</thead>
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<td>.276**</td>
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<td>.018</td>
<td>.200**</td>
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<tr>
<td>strategy</td>
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<td>-.190**</td>
<td>.324**</td>
<td>-.187**</td>
</tr>
<tr>
<td>value</td>
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<td>-.190**</td>
<td>.755**</td>
<td>1</td>
<td>.176**</td>
<td>.596**</td>
</tr>
<tr>
<td>Performance</td>
<td>.018</td>
<td>.324**</td>
<td>.038</td>
<td>.176**</td>
<td>1</td>
<td>.214**</td>
</tr>
<tr>
<td>Achievement</td>
<td>.200**</td>
<td>-.187**</td>
<td>.648**</td>
<td>.596**</td>
<td>.214**</td>
<td>1</td>
</tr>
<tr>
<td>Stimulation</td>
<td>.215**</td>
<td>-.074</td>
<td>.643**</td>
<td>.686**</td>
<td>.275**</td>
<td>.566**</td>
</tr>
</tbody>
</table>

Note: ** $p<.01$, two tailed.

RQ3: What is the relationship between junior college students’ personality and their motivation?

Person correlation coefficients were computed to assess the relationship between the construct of personality and motivation. The correlation coefficients indicate that there is positive and significant relationship between chemistry academic achievement and overall motivation ($p < .05$). Some significant differences were observed.

First of all, Neuroticism was negatively related with achievement goal ($r=.145$, $p<.05$) and learning environment stimulation($r=.115$, $p < .05$). Similarly, Extraversion was negatively related with achievement goal ($r=.152$, $p < .05$) and learning environment stimulation($r=.117$, $p < .05$). Conscientiousness was also negatively related with achievement goal ($r=.152$, $p < .05$). Openness and Agreeableness do not have any significant relation with each construct of motivation.

Table 5: Correlations between Each Construct of Personality and Motivation

<table>
<thead>
<tr>
<th></th>
<th>Neuroticism</th>
<th>extraversion</th>
<th>openness</th>
<th>agreeableness</th>
<th>conscientiousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>efficacy</td>
<td>.037</td>
<td>.077</td>
<td>-.033</td>
<td>-.014</td>
<td>.028</td>
</tr>
<tr>
<td>strategy</td>
<td>-.098</td>
<td>-.077</td>
<td>-.063</td>
<td>.010</td>
<td>-.036</td>
</tr>
<tr>
<td>value</td>
<td>-.090</td>
<td>-.102</td>
<td>-.022</td>
<td>-.024</td>
<td>-.089</td>
</tr>
<tr>
<td>Performance</td>
<td>-.041</td>
<td>-.066</td>
<td>-.026</td>
<td>-.044</td>
<td>-.099</td>
</tr>
<tr>
<td>Achievement</td>
<td>-.145**</td>
<td>-.152**</td>
<td>-.054</td>
<td>-.039</td>
<td>-.112**</td>
</tr>
<tr>
<td>Stimulation</td>
<td>-.115**</td>
<td>-.117**</td>
<td>-.108</td>
<td>-.015</td>
<td>-.074</td>
</tr>
</tbody>
</table>

Note: ** $p<.01$, two tailed.
5. Discussions and Conclusions

The study demonstrated that only one type of personality (i.e. extraversion) had positive relationship with chemistry achievement. The finding was in agreement with previous studies (Chamorro-Premuzic & Furnham, 2003; Rothstein, Paunonen, Rush & King, 1994) because Extraversion was displayed through a higher degree of talkativeness, sociability and assertiveness. It seemed to show that students benefited from having this characteristics in Chemistry learning.

Also, chemistry academic achievement and overall motivation had positive and significant relationship, especially, higher motivation led to a greater achievement in chemistry academic performance, and vice versa. The finding echoed previous studies (Gan, 2003; Oxford & Nyikons, 1989; Yang, 1999) in which they found strong motivation might result in increased attainment and a feeling of progress, which could in turn enhance motivation and facilitate further effort (Gan, 2003, p.73).

In terms of the relationship between each construct of personality and motivation, we found that Neuroticism was negatively related with achievement goal and learning environment stimulation. It might be due to the following fact that regarding neuroticism, individuals who experienced anxiety, self-doubt and negative emotionality were likely to be disengaged from the learning process and might not persist when facing difficulties (Miller, 1991). Thus, it was possible that Neuroticism had negative relation with achievement goal, which was the goal the learners aimed to accomplish so as to gain the recognition from their peers and superiors.

Extraversion and Conscientiousness were negatively related with achievement goal. In terms of openness, learners who scored high on this trait had a strong intellectual curiosity and were eager to learn. In this study, Openness did not have any significant relation with each construct of motivation in learning Chemistry.

To conclude, our results make a contribution to our understanding of academic achievement both by identifying a number of linkages between personality, motivation and academic achievement.

6. Implication, Limitation and Suggestions

The finding of the study has found support for the hypothesis that an individual's learning orientation is related to their personality. The role an individual's personality and motivation may play in the learning process as reported in the study of Busato, Prins, Elshout and Hamaker (2000). Based on the findings, several pedagogical implications were provided for science teachers. First,
the results of this study indicated that there were statistically significant relationships between certain personality preferences and chemistry academic achievement. Therefore, it is important for teachers to be more aware of the differences in their students and ensure that their courses content that appeal to students with their personalities. In addition, science teachers should utilize a variety of tasks and strategies to accommodate students’ needs and motivate them so that high motivation students would preserve motivation in junior college, and would build the confidence of the low motivation group in learning. Also, students should be taught to be more aware of their personalities, namely their weakness and strengths and employ strategies that match with their strengths in order to be involved more actively and effectively in their own learning. Although the study sheds some valuable insights into the influence of personality traits and motivation on chemistry academic achievement, this study has some limitations. Firstly, this study is limited by using convenience sampling. Though the findings can be used as a reference for future more refined studies, results of the study should be generalized with caution. Secondly, future research could investigate the complex nature of academic achievement by examining other individual difference factors (e.g. intelligence, learning styles) as well as environmental factors such as socioeconomic status as predictors of academic achievement. Also, replications of this study in other colleges (e.g., liberal arts, design or engineering), more participants, or with diverse student populations is encouraged.

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學生人格特質與學習動機對化學學習成就之相關研究

A Study of Personality, Motivation and Chemistry Academic Achievement

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摘要

本研究旨在探討學生人格特質與學習動機對化學學習成就之相關性。共 326 位護專學生參與研究，研究工具採用多位學者研發之人格特質量表、學習動機問卷。研究結果發現學生人格特質中外向性與其化學成就有顯著相關。再者，學生的學習動機與化學學習成就之研究有顯著關係。此外，學生的人格特質與學習動機顯示，人格特質中之情緒敏感性與外向性與動機之成就目標呈負相關；勤勉正直性則與學習動機的求知興趣、自我成長與課業進展有顯著負相關，外向性與親和性與動機之各構面無顯著相關。

關鍵字: 人格特質、學習動機、化學學習成就

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