Exploring the relationship of creative thinking to reading and writing

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A B S T R A C T

This study explores if extensive practice in reading or writing is related to high creative performance. In total, 196 university students participated in the study by filling out a questionnaire and completing a creativity test. The questionnaire inquires the total courses taken in the school year, total hours spent on reading, total hours on writing, and background information. The results indicated that students who spent more time on reading/writing performed significantly better on the creativity test. This study concludes that creativity scores, especially scores of elaboration, are significantly correlated with attitudes toward reading/writing, and the amount of time spent on reading/writing.

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1. Introduction

A significant amount of current research in education (Amabile, 1983, 1985, 1989; Brown, 1989; Guilford, 1981; Plucker, Beghetto, & Dow, 2004) has recognized that creative abilities are essential in solving complex individual, social, and global problems. The world now is faced with ever-increasing problems that require solutions form creative talents. Education around the world aims at developing not only knowledgeable workers but also creative thinkers. With such understanding, promoting creativity has emerged as a major educational issue in Taiwan (Le Métais, 2003; Pan, Yang, Chou, & Hong, 2003; Sharp & Le Métais, 2000).

International comparisons on test scores of mathematics and science have shown that students in Taiwan perform better than their counterparts in many other countries (Chen & Stevenson, 1995; PISA, 2006; Stevenson & Stigler, 1992; the TIMSS, 1995, 1999, 2003, 2007). However, test scores of creative thinking have not shown similar outstanding results (Wang, 2007; Wang & Chu, 1975), nor have the test scores of reading literacy (PISA, 2006). After reviewing the test scores, some may wonder why students who are good at solving math problems are bad at solving creativity problems, and also poor at reading literacy. Is this because reading literacy and creative thinking require different abilities from solving math problems? Could similar performances on creative thinking and reading literacy imply that there is a link between the two?

In the above international comparisons, creative performance has been referred to as the results of a creativity test. This study, using a similar creativity test (the Abbreviated Torrance Test for Adults, the ATTA), adopts the Torrance research definition (1965, 1966, 1988): Creative thinking is the ability to sense problems, make guesses, generate new ideas, and communicate the results. With this view of creativity, Torrance (1988, 2000), and also Taylor and Sacks (1981) have suggested that creative potential exists among all people and can be improved through learning. Based on this conception, many
researchers (McVey, 2008; Sak, 2004; Scanlon, 2006; Smith, Paradise, & Smith, 2000; Sturgell, 2008) have advocated the idea that creativity can be encouraged through learning activities, especially reading and/or writing.

Thinking skills are closely related to language development (Piaget, 2002; Vygotsky, 1986), and it is highly possible that creative thinking has a certain connection with reading and writing abilities. According to the literature (McVey, 2008; Sak, 2004; Scanlon, 2006; Smith et al., 2000; Sturgell, 2008), creativity is consistently associated with the abilities that are required for reading and writing. The traits that are encouraged by reading and writing appear to have the same characteristics that creativity researchers suggest foster creativity, such as the freedom and ability to communicate ideas (Amabile, 1996; Beghetto, 2005; Cropley, 1992, 1997; Gardner, 1988; Torrance, 1992), an emphasis on self-discovery (Amabile, 1996), and attention to the individual (Albert, 1980; Harrington, Block, & Block, 1987). Also, when examining the relationship between creative abilities and test scores of different subjects, Wang (2007) discovered that the creative ability of elaboration significantly and positively correlated with English reading and writing scores, but not with math scores.

A large body of research explores if learning activities in the classrooms can contribute to creative development. Some studies (Branowsky & Botel, 1974; Messman, 1991; Otto, 1991; Sak, 2004), targeting gifted children or children in general, endorsed the idea of fostering creativity through classroom reading and writing activities. Other studies (Annis, 1998; Chen, Bernard, & Hsu, 2005; Zachopoulou, Trevlas, & Konstadiniou, 2006) endeavored to design creativity courses through different learning activities, including reading and writing for preschool children and college students. The above studies provided qualitative observation of how structured reading and/or writing activities in the classrooms encouraged students to generate creative ideas and projects.

However, there seems to be little evidence about fostering creativity through personal learning activities. No empirical-based evidence has indicated if personal reading or writing habits or practices, especially unstructured and unorganized activities outside the classroom, are related to the development of creative thinking.

2. Purpose of the study

Therefore, the primary objective of this study is to understand if personal reading or writing practices are related to personal creative performance. By comparing the creativity test scores of students with their self-reported scales on attitudes, habits toward reading and writing, and the hours spent on reading and writing activities, this study explores if there is any correlational link of creative thinking to reading and writing. With statistical evidence, this study attempts to understand if students who enjoy reading and/or writing, who have the habit of regular reading and/or writing practices, or who spend more time on reading and/or writing would perform better on a creativity test.

3. Significance of the research

Even though creative abilities have been viewed as critical in many endeavors, such as art, science, medicine, and business, research about how education can promote creativity has not been as extensive as expected. Research that aims toward promoting creativity tends to focus on planning a creative way to teach a certain subject (e.g., Chen et al., 2005), or designing a special program outside the regular curricula (e.g., Zachopoulou et al., 2006). Whether creativity can be developed through regular personal practices (extensive reading, habitual writing, regular reading and writing courses within regular curricula) have not been properly addressed. This study can be beneficial for all students, especially those who are not in any gifted program, or those who cannot afford to take any special program outside the regular curricula, if it can be shown that any regular practice has value for fostering creative thinking, and also if it provides empirical evidence that verifies the assumption that extensive reading and writing facilitate creative performance.

4. Defining creative thinking

Before discussing in detail creativity research, it is necessary to define the concept of creativity in this paper. As mentioned earlier, Torrance (1988) and Taylor and Sacks (1981) advocated everyday creativity. Following this notion, a growing number of researchers (e.g., Craft, 2001; Duffy, 1998; Feldman, 1999) have viewed creativity as everyday, i.e., a necessary thinking skill for everyone. Utilizing this conception, Torrance (1965, 1966, 1988) defined creative thinking as the ability to identify problems, make guesses, produce new ideas, and communicate the results. As Duffy (1998) suggested, creative thinking is the ability to see things in new and original ways, to learn from experience and relating it to new situations, to think in unconventional and unique ways, to use non-traditional approaches to solving problems, and creating something unique and original.

Using the same definition, Goff and Torrance (2002) developed the ATTA, a creativity test. This test assesses creative thinking ability which includes the ability of fluency (the fluency of ideas), the ability of originality (the uniqueness of ideas), the ability of elaboration (the details of an idea), and the ability of flexibility (the variety of ideas used to solve problems). Adopting the ATTA as a measurement tool for creative thinking in this study, creative performance in this paper means the test results of the ATTA. The detailed description of the ATTA, including the reliability and credibility, appears in the section of measurement tools.
5. Literature review

5.1. Factors that facilitate creativity

According to many researchers (Niu & Sternberg, 2003; Rudowicz, Lok, & Kitto, 1995; Straus & Straus, 1968), cultural and educational factors influence different creative performances, and creativity can be fostered through teaching activities (Neethling, 2000; Torrance, 1987, 1988). Many creativity studies identify the various traits that teachers should value and encourage in their students. Important aspects include cognitive, motivation, personality, and social factors.

For cognitive factors, creativity can be promoted through thinking, remembering, and reasoning (Campbell, 1960; Cropley, 1992; Pollert, Feldhusen, Van Mondfrans, & Treffinger, 1969). For motivation factors, self-discovery (Amabile, 1996), autonomy, courage, curiosity, willingness, and task commitment are encouraged (Beghetto, 2005; Cannatella, 2004; Cropley, 1992, 1997; Gardner, 1988; Torrance, 1992). For personality factors, self-confidence, self-esteem, determination, persistence, tolerance for ambiguity, and the openness to new experiences are important for creative thinking (Amabile, 1996; Bean, 1992; Beghetto, 2005; Cannatella, 2004; Cropley, 1992, 1997; Diakidoy & Kanari, 1999; Gardner, 1988; Torrance, 1992; Von Eschenbach & Noland, 1981). The social factors include abundant resources, independence, nonconformity, and the ability to communicate ideas (Amabile, 1996; Beghetto, 2005; Cropley, 1992, 1997; Gardner, 1988; Torrance, 1992).

As Ogilvie (1974) particularly emphasizes, an environment that fosters creativity “provides for both freedom of expression and good quality association reservoirs” (p. 129). In accordance with these suggested factors, the most important characteristics for a creative individual are determination, curiosity, independence (in judgement and thinking), persistence, self-confidence, and a willingness to take risks (Diakidoy & Kanari, 1999; Torrance, 1975; Von Eschenbach & Noland, 1981). In a series of studies, Torrance (1975) and Fryer (1989, 1994, 1996) confirm that teachers who value the characteristics that facilitate creativity actually help students achieve a high level of creative performance.

5.2. Reading, writing, and creativity

According to the above review, many of the characteristics that facilitate creativity can be developed through reading or writing practices such as thinking, remembering, reasoning, feeling curious, exploring, and freedom of expression. The relationship between reading, writing, and thinking has been studied most extensively. Researchers have demonstrated how reading and writing are related to thinking (Moffett & Wagner, 1983; Pearson & Tierney, 1984; Stanford & Roark, 1974; Stanton, 1984), and how reading and writing instruction can encourage critical thinking (Chapple & Curtis, 2000; Davidson, 1994).

Reading and writing activities have been intuitively connected with creative activities that foster creative thinking. This is mainly because reading and writing often require critical, analytical, and self-expressive abilities, as well as a sense of self-discovery. As Sturgell (2008) points out, reading texts provide abundant resources for creative ideas to flourish. In a recent article, McVey (2008) elaborates that any kind of writing is itself creative, and reading and writing should be promoted for “endless creative possibilities” (p. 294). To encourage the characteristics that facilitate creativity, researchers have designed certain creativity courses through reading and writing activities (Annis, 1998; Chen et al., 2005; Zachopoulou et al., 2006).

In a summary of the related literature, Smith et al. (2000) outlined the essential elements that prepare a creative mind: knowledge and behavior. According to them, “knowledge” refers to resources, techniques, and related information. In order to create something in a certain field, one needs to have resources, techniques, and information in the field. On the other hand, “behavior” requires habitual acts. To prepare a creative mind means to encourage the habitual act of learning something new, seeking constructive criticism, thinking and incubating, and putting knowledge to work. These elements are actually part of the everyday reading and writing experience: reading to accumulate knowledge, and writing that puts knowledge and personal ideas to work. In addition, by examining the relationship between creative abilities and test scores from different subjects, Wang (2007) discovered that there was a significant correlation between creativity scores, especially in elaboration, and reading and writing scores.

The above review of literature brings indirect evidence to support the conclusion that reading and writing are in some ways linked with fostering creativity. However, it is still a speculation rather than a conclusion supported by empirical evidence. In the above studies, researchers observed behavior where creative elements were obvious. Even for the reading and writing activities designed for gifted children, and the special courses outside the regular curricula, the findings simply reported observations on how the participated students generated creative works and ideas. No statistical evidence has shown how a person, not registered in a gifted program or special program, simply spending more time on reading and/or writing would score higher on a creativity test, or how a person who likes to read and/or write would be more creative in solving verbal or figural problems. It is this unexplored area that this study attempts to investigate: it intends to provide statistical evidence to support that personal reading and writing practices can help fostering creative thinking.

6. Research questions

According to the purpose of the research, this study explores if there is any correlative link of creative performance to personal reading and writing practices. It intends to answer the following questions: (1) Does personal attitude toward reading and writing influence creative performance? (2) Do students with different reading or writing habits, such as reading
books or reading online, perform differently on a creativity test? (3) Do more hours spent on reading and writing in general improve scores on a creativity test?

7. Methods

7.1. Population and procedure

The sampling subjects in this study were students from 18 to 21 in a university in Taiwan. University students in the departments of English and Chinese were required to take reading and writing courses; these courses were not required in the departments of Mathematics and Information Science. Therefore, participants were solicited from the departments of English, Chinese, Mathematics, and Information Science. Teachers in selected classes in these departments encouraged the students to voluntarily participate in the project. The students who participated in the project were able to receive their creativity assessment results for free. As an incentive to make students take the research seriously and make them keep an accurate record of their reading and writing time, a gift coupon was provided to every student who participated and fulfilled the requirements in the research. During regular class time, according to the instruction of the researcher, the participants filled out a questionnaire and completed a creativity test, the Abbreviated Torrance Test for Adults (ATTA).

7.2. Measurement tools

Two measurement tools were employed: a questionnaire and a creativity test (ATTA). The tool used to measure creative thinking ability was the Abbreviated Torrance Test for Adults (ATTA). The ATTA is a shortened version of the Torrance Test of Creative Thinking (TTCT), a widely used and researched creativity test (Cramond, 1998; Rosenthal, DeMers, Stilwell, Graybeal, & Zins, 1983; Runco & Albert, 1985). The TTCT was developed mainly for children and the ATTA for adults. The time limit for adults to complete the activities in the creativity test is shorter; it takes about 15 min to complete the ATTA and about 50 min for the TTCT. The ATTA has been proven to be as reliable and valid as the TTCT (Goff & Torrance, 2000; Torrance, 1981, 1988, 2000; Torrance & Safer, 1999), and the traditional Chinese version has been extensively tested and has proven to be valid in Taiwan (Chen, 2006). Since the participants in this study were young adults in Taiwan, the ATTA was selected as a measurement tool.

The test was employed in this study because of its validity and its problem-solving nature. It contains three activities: one verbal and two figural tests. Within a set time limit, the students are required to identify problems, make guesses, and create ideas to solve problems or communicate ideas by writing sentences or phrases and by drawing pictures. The ATTA assesses how many ideas (fluency) can be generated within the set time, how unique (originality) the ideas are, how many details (elaboration) can be added to an original idea, and how many varieties (flexibility) of ideas can be generated to solve one problem.

Analysis of the activities in the ATTA shows participants’ fluency, originality, elaboration, flexibility, and creative indexes. The result of the ATTA provides the creativity index (CI), a composite of creative indicators plus four sub-scores: (1) fluency; (2) originality; (3) elaboration; (4) flexibility. The four creative components are scaled as 11–19. The overall creative performance, the CI, is ranked with seven levels, with values ranging from one to seven (1 = Minimal; 2 = Low; 3 = Below Average; 4 = Average; 5 = Above Average; 6 = High; 7 = Substantial).

The other measurement tool, the questionnaire, inquired about (1) personal attitudes toward reading and writing; (2) estimated hours spent on different reading and writing activities; and (3) background information. The questionnaire surveyed student demographic information (age, gender, major, minor), courses taken in the current school year, student attitudes toward reading and writing, and the hours students spent on different reading and writing activities.

Student attitudes toward reading and writing were surveyed with a 5-point Likert scale (5 = strongly agree; 1 = strongly disagree). The items in the attitude assessment included positive statements (such as “I enjoy reading very much”) and negative statements (such as “reading makes me feel bored”). If a person scores high on a positive statement, or scores low on a negative statement, this means that the person holds a positive attitude toward reading or writing. However, if a person scores low on a positive statement, or scores high on a negative statement, it shows a negative attitude.

On the other hand, the self-evaluated hours spent on various reading and writing activities were rated with a 6-point Likert scale (6 = more than 15 h a week; 5 = 11–15 h a week; 4 = 6–10 h a week; 3 = 1–5 h a week; 2 = less than 1 h a week; 1 = never). Different reading activities included reading (1) textbooks or assigned reading texts in class, (2) books for fun and pleasure, (3) magazines or articles, (4) newspapers, (5) online news, (6) on a BBS (Bulletin Board System) or blog. Writing activities were writing (1) their essay assignments, (2) articles for fun, (3) personal diaries, (4) personal blogs, and (5) entries on a BBS or online forum.

8. Results and discussion

The statistical program SPSS was used to organize and compile the collected data. In this study, 196 surveys and creativity tests were collected. Except for the respondents who did not provide background information, there were 122 female and 69 male students from the departments of English (N = 55), Chinese (N = 56), Information Science (N = 38), and Mathematics
Table 1
Summary of participants.

<table>
<thead>
<tr>
<th>Major</th>
<th>Male</th>
<th>Female</th>
<th>Missing</th>
<th>Total (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>6</td>
<td>49</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>Chinese</td>
<td>6</td>
<td>48</td>
<td>2</td>
<td>56</td>
</tr>
<tr>
<td>Information Science</td>
<td>28</td>
<td>7</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>Mathematics</td>
<td>29</td>
<td>18</td>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>122</td>
<td>5</td>
<td>196</td>
</tr>
</tbody>
</table>

(N = 47). Table 1 summarizes the background information of the participants. Also, the majority of participants from the departments of humanities were female, whereas most of those from the departments of science were male.

An analysis of the data from the whole sample revealed that students from different genders performed significantly different on the creativity test. However, no significant gender differences could be identified within each department; also, evidence regarding gender differences on creative performance in the literature is equivocal (Wang, 2007). Therefore, gender difference on creative performance was not explored in this paper.

The Pearson correlation tests among variables were tested to explore any significant relation. The results described here are organized as follows: (1) the relationship between creativity and attitudes toward reading and writing; (2) the relationship between creativity and hours spent on different reading and writing activities; (3) the relationship between creativity and hours spent on reading and writing in general.

8.1. Creativity and attitudes toward reading and writing

According to the results of the Pearson correlation tests, significant correlations were observed between creative performance and student attitudes toward reading and writing. Table 2 presents significant correlations between creative abilities and reading attitudes. Obviously, positive reading attitudes were significantly correlated with high creativity. The significant correlation between enjoying discussing books and creativity (elaboration \( r = 0.172 \), CI \( r = 0.143 \), significant at the 0.05 level) indicates that the more one likes to discuss books, the better one performs on the creativity test. Also, the more one enjoys reading, the higher the creativity test scores are (elaboration \( r = 0.170 \), CI \( r = 0.161 \), significant at the 0.05 level).

Moreover, negative reading attitudes significantly correlated with low creativity. The negative correlation once again supports the hypothesis that reading fosters creativity. The more a student disagrees that he or she reads only when required, the higher the student scores on the ATTA (fluency \( r = -0.198 \), elaboration \( r = -0.245 \), CI \( r = -0.216 \), significant at the 0.01 level). The more a student disagrees that reading makes him or her feel bored, the higher the scores are on the creativity test (fluency \( r = -0.212 \), elaboration \( r = -0.294 \), flexibility \( r = -0.206 \), CI \( r = -0.293 \), significant at the 0.01 level). Regarding attitudes toward writing, significant correlations were also observed. As Table 3 shows, significant and negative correlations were noted between creative performance and the following two statements: (1) one only writes when required (CI \( r = -0.153 \), significant at the 0.05 level); and (2) writing makes one feel bored (CI \( r = -0.255 \), significant at the 0.01 level). Therefore, students who have low creative performance scores tend to write only when required, and tend to feel bored

Table 2
Correlations between creativity and reading attitudes.

<table>
<thead>
<tr>
<th></th>
<th>Total sample (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elaboration</td>
<td>0.172*</td>
</tr>
<tr>
<td>Creativity index</td>
<td>0.142*</td>
</tr>
<tr>
<td>Enjoy reading</td>
<td></td>
</tr>
<tr>
<td>Elaboration</td>
<td>0.170*</td>
</tr>
<tr>
<td>Creativity index</td>
<td>0.161*</td>
</tr>
<tr>
<td>Do not like reading and only read when required</td>
<td></td>
</tr>
<tr>
<td>Fluency</td>
<td>-0.198*</td>
</tr>
<tr>
<td>Elaboration</td>
<td>-0.245*</td>
</tr>
<tr>
<td>Creativity index</td>
<td>-0.216*</td>
</tr>
<tr>
<td>Feel bored when reading</td>
<td></td>
</tr>
<tr>
<td>Fluency</td>
<td>-0.212*</td>
</tr>
<tr>
<td>Elaboration</td>
<td>-0.294*</td>
</tr>
<tr>
<td>Flexibility</td>
<td>-0.206*</td>
</tr>
<tr>
<td>Creativity index</td>
<td>-0.293*</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
Table 3
Correlations between creativity and writing attitudes.

<table>
<thead>
<tr>
<th>Only write when required</th>
<th>Total sample (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluency</td>
<td>-0.173*</td>
</tr>
<tr>
<td>Elaboration</td>
<td>-0.235**</td>
</tr>
<tr>
<td>Creativity index</td>
<td>-0.153*</td>
</tr>
</tbody>
</table>

Writing makes one bored

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>-0.168*</td>
</tr>
<tr>
<td>Originality</td>
<td>-0.180*</td>
</tr>
<tr>
<td>Elaboration</td>
<td>-0.226*</td>
</tr>
<tr>
<td>Flexibility</td>
<td>-0.156*</td>
</tr>
<tr>
<td>Creativity index</td>
<td>-0.255*</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

when performing any writing activity. However, keeping a diary, enjoyment of writing, and a preference for discussing writing did not seem to affect the creative performance

8.2. Creativity and hours on different reading and writing activities

As for hours spent on reading and writing activities, significant and positive correlations were discovered between creative ability and the hours spent on the following activities: (1) reading for fun (fluency $r = 0.165$); (2) reading magazines or articles (fluency $r = 0.176$, elaboration $r = 0.150$, and CI $r = 0.170$); (3) reading online news (originality $r = 0.145$); and (4) writing assignments (originality $r = 0.171$). Table 4 indicates the detailed correlations. However, the hours spent on some reading and writing activities did not influence creative performance, e.g., reading a textbook, blog, or BBS.

8.3. Creativity and hours on reading and writing in general

Analyses of the data consistently found that the majority of students who rated themselves highest on the amount of time spent on reading or writing (rated 6: more than 15 h a week; rated 5: 11–15 h a week) were students from the departments of English and Chinese. Thus, courses taken during the school year for each participant were further examined to understand any differences in the amount of time spent on reading or writing required by the different departments. Students from the departments of English and Chinese were required to take more credits in reading and/or writing, and they had more essay-type assignments than those in the departments of science and mathematics. English majors, who were required to read and write not only in their first language (L1) but also in a second language (L2), took more credits than Chinese majors in courses that require extensive reading and writing assignments. However, students from the departments of science and mathematics took few reading courses, and no writing courses.

According to their self-reported time on reading and writing activities, students of different majors spent a different amount of time on reading and writing activities. For reading activities, although they spent a similar amount of time reading textbooks, newspapers, online news, blogs, and reading for fun, on average, English ($M = 3.66$) majors spent the most time doing these activities, followed by Science ($M = 3.47$), Chinese ($M = 3.39$), and Math majors ($M = 3.28$). What is more important is that they spent a significantly different amount of time reading articles (Table 5). Among them, English

Table 4
Correlations between creativity and hours on different reading or writing activities.

<table>
<thead>
<tr>
<th>Hours on reading for fun</th>
<th>Total sample (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluency</td>
<td>0.165*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours on reading magazines or articles</th>
<th>Total sample (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>0.176*</td>
</tr>
<tr>
<td>Elaboration</td>
<td>0.150*</td>
</tr>
<tr>
<td>Creativity index</td>
<td>0.226*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours on reading online news</th>
<th>Total sample (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>0.145*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours on writing assignments</th>
<th>Total sample (N = 196)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>0.171*</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
majors spent the most time reading articles, approximately 5–6 h a week (M = 3.75, SD = 1.00), followed by Science majors (M = 3.29, SD = 1.03) and Chinese majors (M = 3.02, SD = 0.96). Math majors spent the least time, approximately an hour a week (M = 2.72, SD = 0.97).

For writing activities, all the students spent a relatively similar amount of time writing their school assignments, with English majors spending the most time (M = 4.06, SD = 0.98), followed by Chinese (M = 4.02, SD = 1.06), Information Science (M = 3.82, SD = 1.16), and Math majors (M = 3.73, SD = 1.20). However, they spent a significantly different amount of time writing articles for fun and on personal blogs (Table 5). Among them, Chinese and English majors spent much more time on writing for fun (CH: M = 3.58, SD = 1.71; ENG: M = 3.31, SD = 1.63) and on personal blogs (CH: M = 3.73, SD = 1.65; ENG: M = 3.58, SD = 1.50) than Information Science and Math majors (for fun IS: M = 2.13, SD = 1.48; Math: M = 2.36, SD = 1.77) (blogs IS: M = 2.84, SD = 1.84; Math: M = 2.76, SD = 1.76).

Therefore, the ANOVA was performed to test if different department groups performed differently on the creativity test. The results indicate significant differences. As Table 6 demonstrates, the four department groups performed significantly different on the overall creative performance (level of creativity index: F = 6.124, p < 0.001). As for each component of creative ability, the differences were also obvious (Table 6) while the most prominent difference appeared in the ability of elaboration (F = 6.355, p < 0.001).

The following paragraphs describe the different performances in the ATTA of the four departments. Obviously, the majority of English majors (32.7%) and Chinese majors (33.9%) demonstrate a high level of creativity (CI = 6), whereas the majority of Science majors (44.7%) and Math majors (27.7%) show an average level of creativity (CI = 4). Table 7 shows the frequency distributions of the CI in the four departments.

Table 6
Significant differences in creative performance between different majors.

<table>
<thead>
<tr>
<th>Majors (N = 196)</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of creativity index</td>
<td>6.124</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fluency</td>
<td>3.069</td>
<td>0.004</td>
</tr>
<tr>
<td>Originality</td>
<td>2.308</td>
<td>0.036</td>
</tr>
<tr>
<td>Elaboration</td>
<td>6.535</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Flexibility</td>
<td>2.166</td>
<td>0.048</td>
</tr>
</tbody>
</table>

Table 7
Distribution of the level of the creativity index (CI).

<table>
<thead>
<tr>
<th>Major</th>
<th>CI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Min.</td>
<td>2 Low</td>
</tr>
<tr>
<td>English</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chinese</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Science</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

CI: 1 = Minimal; 2 = Low; 3 = Below Average; 4 = Average; 5 = Above Average; 6 = High; 7 = Substantial.

Table 8
Means and standard deviations of the scores on the ATTA.

<table>
<thead>
<tr>
<th>Major</th>
<th>Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fluency</td>
</tr>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td>English</td>
<td>15.41</td>
</tr>
<tr>
<td>Chinese</td>
<td>14.63</td>
</tr>
<tr>
<td>Science</td>
<td>14.24</td>
</tr>
<tr>
<td>Math</td>
<td>14.23</td>
</tr>
</tbody>
</table>

Scaled scores: fluency, originality, elaboration, and flexibility = 11–19; creativity Level = 1–7.
ANOVA shows significant differences between the groups.
Although science majors demonstrated the highest mean scores on the ability of originality, English majors scored the highest in almost every other aspect of the test. Table 8 compares the means and standard deviations of the scores of creativity index and the four sub-scores.

Generally speaking, students who spent more time on reading and writing performed better on the creativity test. English majors spent the most time reading and writing (in both L1 and L2) and scored the highest on the creativity test, while Math majors spent the least time and scored the lowest. Although Science majors spent more time on reading activities than Chinese majors, Chinese majors spent much more time on writing activities. Spending more time on reading may be the reason why Science majors scored higher than Chinese majors on the component abilities of originality and flexibility, though their overall scores on the creativity index were lower than those of Chinese majors.

9. Conclusion

In the significant correlations between creativity and reading and writing that are identified in this study (Tables 2–4), the ability of elaboration constantly emerges as the most prominent and constant connection. Even in the results of the ANOVA (Table 6), the most distinct difference in creative performance among the four department groups is the ability of elaboration. Originality and flexibility seem to be less differentiated among the four groups. The above findings suggest that habitual reading and writing have a significant and positive relationship with the ability of elaboration.

According to Goff and Torrance (2002), elaboration is the ability to embellish ideas with details. For example, when given a triangle figure, a student may come up with an original idea to draw a house with the figure, and elaboration scoring measures the number of details (such as windows or fences) that are added to the house. Adding rich details raises the elaboration scores, and increases the overall creative performance. According to the above findings, reading and writing have a positive relationship with the ability to enrich original ideas with details.

This implication sheds light on the question at the beginning of this paper: Why do students who perform well on math tests not perform as well on tests of creativity and reading literacy? Solving a math problem does not necessarily require rich verbal details. However, performing well on creativity and reading literacy tests requires the ability to provide rich verbal details. This may explain why students who score high on TIMSS mathematics and science tests do not score as well on creativity tests or the PISA test of reading literacy.

This does not necessarily mean humanities students are generally more creative than mathematics and science students. However, it does show that humanities students spent significantly more time on reading and writing, and also that required courses in the humanities offered more opportunities for students to develop reading and writing habits. With the significant and positive relationship of creativity to reading and writing attitudes, habits, and time spent, it is likely that some component creative abilities, such as the ability of elaboration, may naturally and more regularly develop from the humanities than from other subject disciplines.

Another possibility is that a creativity test may not measure creative thinking across all domains; rather, it may be more of a measure of linguistic ability. In each activity in the ATTA, either verbal or figural, the activity requires linguistic ability. The respondent of the test needs to write sentences to express ideas (linguistic ability) in the verbally activity, and to write a title that describes (linguistic ability) each drawing in the figural activities. However, it is not the scope of this study to determine if the ATTA tends to measure linguistic creative ability better than creative thinking across all domains. Future research may explore the possibility.

From the above statistical evidence, this study confirms that there is a positive relationship with reading and writing to creativity, especially in the ability of elaboration. Habitual reading and writing, especially in different languages, is related to high performance in the ability of elaboration. Obviously, a positive attitude toward reading and writing has an impact on creative performance, and the number of hours spent on different reading and writing activities influences creative thinking. A higher amount of time spent on reading or writing, either within or outside the regular curricula, is related to higher creative performance. Students from different majors perform differently, though further study may be needed to interpret the results. For now, educators and parents should be aware that in order to promote creative thinking, it is best to develop a positive attitude toward reading and writing, and also practice extensive reading and writing, and most probably in different languages.

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References


