Developmental trends of divergent thinking and feeling across different grades for Taiwanese adolescence between 1990's and 2010's

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ABSTRACT

Previous studies regarding developmental trends of creativity in adolescence rarely focused on both cognitive and affective factors of creativity. In Taiwan, the survey in this field also lacked during these two decades. Therefore, this study aimed to understand Taiwanese students' developmental trends of creativity in both cognitive and affective aspects. The researchers analyzed the difference between divergent thinking and divergent feeling of Taiwanese adolescent students across different grades as well as the linear trend. The difference of divergent thinking and divergent feeling scores between this study and the 1990s' was also examined. Participants included 1674 fifth-grade to eleventh-grade students (806 boys, 51.73%). The results showed that divergent thinking scores as cognitive aspect significantly enhanced as grade levels increased. The divergent feeling scores as affective aspect slightly enhanced as grade levels increased, but slumped in the sixth grade and steeply ascended in the eleventh grade. When the divergent thinking scores of the current students were compared with the scores of the students in 1990s, the types of developmental trend were different, which was the fluctuation of developmental trend was larger than the current trend which was smoother. The mean scores of current participants for each grade level had less variation than 1990s'. The divergent feeling scores in both 1990s' and 2010s' increase and showed a similar linear upward trend. The results would suggest further investigation and promotion of creativity in education policy.

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1. Introduction

Development of creativity in individuals is an important topic in education and psychology. The best known research on developmental trends of creativity is that of Torrance (1968a,b), who, using the Torrance Tests of Creative Thinking (TTCT), conducted a large-scale study in seven countries and introduced the 4th-grade slump phenomenon. Since then, there have been many studies related to developmental trends of creativity (e.g., Chae, 2003; Charles & Runco, 2001; Cheung, Lau, Chan, & Wu, 2004; Kim, 2011; Lopez, Esquivel, & Houtz, 1993; Lubart & Lautrey, 1995; Urban, 1991); however, the findings have generally been inconsistent (Makera, Jo, & Muammar, 2008). For example, among studies of the 4th-grade slump, several
supported the findings of Torrance (Georgsdottir, Ameel, & Lubart, 2002; Lubart & LaBrey, 1995; Rosenblatt & Winner, 1988; Smolucha & Smolucha, 1985), whereas others yielded different trends (Besançon and Lubart, 2008; Lopez et al., 1993; Maker et al., 2008; Rosenblatt & Winner, 1988; Runco, 1989). Lau and Cheung (2010) analyzed the reasons for these mixed results of past studies of the development of creativity in children and adolescents. They claimed that (1) a relatively narrow age range was included in many studies and (2) sample sizes were small in most studies.

In addition, most of these studies included only the childhood stage, whereas only a few focused on development of creativity in adolescence (Kleibeuker, De Dreu, & Crone, 2013). However, adolescence is a key period in an individual’s development and includes changes in many cognitive abilities (Casey, Jones & Hare, 2008; Collins, Gleason & Sesma, 1997; Hill & Holmbeck, 1986; Steinberg, 2005). Adolescent development plays an important role in shaping an individual’s development of creativity and therefore should be included in future studies.

Creativity is a syndrome with multiple aspects (Mumford & Gustafson, 1988). In addition to cognitive abilities, essential factors in creative performance also include affective characteristics such as personality, motivation, and attitude (Amabile, 1983; Csikszentmihalyi, 1988; Gruber, 1988; Rhodes, 1961; Runco, 2007; Sternberg & Lubart, 1995). These characteristics may not necessarily determine an individual’s current creativity but can serve as indices of future creativity (Jauk, Benedek, & Neubauer, 2014; Runco, 2008). Therefore, in addition to cognitive factors, affective features of development need to be studied when investigating creativity development in students. However, the majority of research related to developmental trends of creativity focused on cognitive process and included only a few factors related to other dimensions.

Moreover, many studies indicated that development of creativity was influenced by social and cultural climates (Ng, 2001; Niu & Sternberg, 2001; Simonton, 1984; Williams et al., 1995). Developmental trends of creativity in individuals may vary from one region and time period to the next. In the previous two decades, Taiwan has gradually expanded the scope of creative education, previously limited to gifted students, to all students across grade levels (Chen, Wu, & Chen, 2005). However, there is still a lack of evaluation and research on the developmental trends of creativity in local Taiwanese students and the changes in developmental trends with time (Hui & Lau, 2010). Therefore, the goal of the present study was to use a large sample spanning many grade levels to investigate trends in creative development among children and adolescents in Taiwan from both the cognitive and affective perspectives and to compare the results with scores of creativity reported during the previous two decades.

1.1. The theory of development of creativity from childhood to adolescence

Creativity is an integrated aggregate of many abilities and psychological processes that are naturally impacted by physical and mental development as one grows. Different views of continuous versus staged development formed when developmental psychologists explored human development (Brim & Kagan, 1980; Smith & Carlsson, 1985). The above views differ regarding whether an observed developmental trend in creativity is due to maturation and experience or due to other changes during various stages in life (Runco & Pritzker, 1999). Certain scholars such as Keegan (1996), who performed a case study, concluded that processes related to creativity develop continuously. Other scholars such as Plucker, Beghetto, & Dow (2004) suggested that while certain processes involved in creativity are general and others are specifically defined, they cannot be classified as merely continuous or stage-based but instead are a blend of both.

The conclusions that scholars have presented regarding developmental trends in creativity in childhood, adolescence, and adulthood are primarily of two tracks: trends associated with cognitive development and those associated with psychosocial development. The cognitive view is primarily based on the theory of cognitive development proposed by Piaget (1970, 1976). Different stages were defined in Piaget’s theory. Children between ages 7 and 11 are in the concrete operational stage, and children older than 11 are in the formal operational stage. Piaget believed that creative imagination is an active assimilation behavior, the frequency of which will not decrease with age. Rather, creative imagination will gradually blend with one’s intellectual development as a result of related accommodation processes. In other words, based on Piaget’s view, creativity development is present in different forms at different developmental stages. Therefore, in a test of creative thinking (e.g., divergent thinking), a certain age group may exhibit a slump trend with time; such a finding does not necessarily represent a real decrease in ability but instead may indicate a change in the way that creativity is presented. When the formal operational stage begins, children start to develop the hypothetico-deductive reasoning ability. The development may influence children to less rely on intuitive thinking (Guignard & Lubart, 2006). Divergent thinking is a more intuitive process compared to logical reasoning. As a result, we speculate that although a slump trend in scores on tests of creative thinking might be observed during the transition from the concrete operational stage in childhood to the formal operational stage in adolescence, creative thinking will gradually advance as adolescents’ cognitive abilities develop during the formal operational stage.

Neuropsychological development also affects development patterns in divergent thinking (Kleibeuker et al., 2013). The prefrontal cortex, which is in charge of cognitive abilities (primarily executive functions), is fully developed in adolescence, although inhibitory abilities are still developing (Casey et al., 2008; Spear, 2000). Therefore, adolescents tend to be more attracted to external stimuli and exhibit more curiosity or risk-taking exploratory behavior (Johnson & Wilbrecht, 2011) and even display more divergent thinking capabilities than do adults (Gray, Buhusi & Schmajuk, 1997). However, development of cognitive abilities does not necessarily lead to creativity. Certain scholars, in contrast, concluded that cognitive development leads to a decrease in creativity in adolescence. For example, Runco et al. (Charles & Runco, 2001; Runco & Charles, 1997) noted that adolescents display a decrease in creativity as their critical thinking skills mature. Lubart and his colleagues
hypothesized that creative thinking abilities decline as logical thinking skills mature in adolescence (Lubart & Georgsdottir, 2004; Lubart & Lauray, 1995; Georgsdottir et al., 2002).

The second view is related to psychosocial development. For example, Kohlberg’s theory of moral development asserts that moral development emerges during middle childhood, i.e., approximately ages 9–10, and is a sign of progression from the pre-conventional stage to the conventional stage, when many thoughts and behaviors of students are prohibited by the norms or expectations of society. Runco (2007) noted that during this transition, processes that are crucial to divergent thinking and creativity might be reduced due to possible pressure from societal norms, resulting in lower student scores on tests of divergent thinking. As a result, Runco concluded that creative potential peaks during childhood and is suppressed with maturation during adolescence. Other contrasting views such as those of Claxton, Pannels, and Rhoads (2005), who used the self-identification view of Rothenberg (1990) in explaining development of creativity, hold that adolescents have parallel needs of being connected and being separated when facing conflicts between social norms and individual development. Creativity demonstrated in adulthood indeed stems from the physiological, psychological, and social changes that occur during adolescence. Adolescents begin to develop an identity. While actively trying to develop independence and self-identity, adolescents also begin to explore the ties with their peers and families. The continuous growth in self-observation and self-identity is a possible reason for growth in creativity tendencies during adolescence. Which development model best captures the developmental trajectory of creativity in an individual during general development? Will factors from cognitive and affective dimensions bring any difference to the developmental trend of creativity? Answers to these questions await empirical studies.

1.2. Studies of creative development in childhood and adolescence

When examining the developmental trend of creativity from childhood to adolescence from the cognitive perspective, studies have yielded inconsistent results in adolescence after 6th grade. Some studies showed a continuous decline after 6th grade. Camp (1994) conducted a longitudinal study to follow a group of American students through 12th grade in the 1970s. The results indicated that creative thinking continued to grow from a very young age to 6th grade but decreased significantly from 6th to 9th grades. Kim (2011) aggregated data from more than 270,000 subjects from 1966, 1974, 1984, 1990, 1998, and 2008 to create a large sample for the Torrance Tests of Creative Thinking (TTCT). The results did not show the 4th-grade slump discovered by Torrance (1968a,b) but demonstrated a declining trend in 5th and 6th grade based on the fluency and originality scores. The fluency scores declined from 6th grade until adulthood. In contrast, the originality scores peaked in 5th grade, declined until high school, and then rose again slightly but not significantly. The above two studies indicated that children’s developmental potential of creativity peaks in 6th grade but continues to decline after adolescence. Certain studies indicated that the trough was in 6th grade and an increase occurred until 9th grade. Claxton et al. (2005) also conducted a longitudinal study to follow a group of 4th grade students over a long period of time in terms of their divergent thinking and divergent feeling development. The results indicated that in terms of divergent thinking, originality in students dropped significantly and bottomed between 4th and 6th grades and then rose between 6th and 9th grades. Kleibeuker et al. (2013) divided 98 Dutch participants into 4 age groups (12–13, 15–16, 18–19, and 25–30) using various tests of creative thinking. Among the test scores, both verbal and visuo-spatial divergent thinking peaked in adolescents in the age range of 15–16. In other words, divergent thinking continued to grow between 6th and 9th grades but dropped slightly between 9th and 12th grades.

Some studies indicated that children’s creative cognition significantly rose again subsequent to the sudden drop after 6th grade. Lee and Choi (2012) surveyed 2248 Korean high schoolers using the Korean Individual Creativity Test. This test measures two domains, creative abilities (flexibility, fluency, originality, elaboration, and sensitivity to thinking) and creative personality traits (curiosity, sensitivity, task commitment, humor, challenge, and leadership during problem solving). The results indicated a downward trend in creative abilities in 7th through 9th grades, which is consistent with the above-mentioned trend observed by Camp (1994) and Kim (2011). This trend reversed and began to rise in late adolescence during 10th and 11th grades and peaked in 11th grade. Overall, figurative creativity of Korean 10th and 11th graders was better than that of their junior high counterparts in 7th through 9th grades. Hong Kong is near Taiwan. Lau and Cheung (2010) investigated divergent thinking in 2479 students from 4th through 9th grades in Hong Kong using the computerized Wallach–Kogan creativity tests. The results indicated a trend different from that observed in Korea. The students’ creativity scores rose between 4th and 5th grades but began to drop between 5th and 6th grades. During their middle and high school years, the students’ creativity scores continued to drop between 6th and 7th grades and then rose during 7th and 9th grades, which differed from the trend in Korea. However, the study of Lau and Cheung (2010) involved only students up to 9th grade and did not study development in late adolescence. To summarize these studies, fluctuations in divergent thinking development in childhood to adolescence generally occur at the transition between elementary and high school. In addition, changes occur during the transition from 9th grade in junior high to senior high school. These changes indicate that divergent thinking is affected not only by physiological maturation and cognitive development but also by interactions between the individual and the external social environment. We should also be mindful that different divergent thinking tests may possibly lead to differences in test results.

When studying development of creativity from the perspective of social affect, Erickson (1963) noted that adolescence is an important period for individuals as they explore life, engage in self-evaluation and develop feelings of self-identity. Although adolescents appear to be primarily pursuing an identity and acceptance by their peers, adolescents are also devel-
oping their own perspectives about themselves and the world. Allison and Schultz (2001) shared a similar viewpoint, i.e., that adolescents begin to develop a basic self-identity starting in 9th grade. Adolescents will learn from the perspective gained through self-identification and will become more confident in undertaking creative activities and, in turn, develop motivation for future creative endeavors. However, there are very few empirical studies that included affective elements when investigating the developmental trends in creativity. Employing the CAP test of Williams (1969), Claxton et al. (2005) performed a longitudinal study of students starting in 4th grade to explore their development of creative thinking and creative tendencies. The results indicated that when looking at the four dimensions of CAP divergent feeling (creative tendencies), namely risk-taking, curiosity, imagination, and complexity, creativity development grew significantly with grade level. A significant increase in scores was found during 6th and 9th grades on all four factors of divergent feeling. However, the study of Korean high schoolers by Lee and Choi (2013) indicated that creative personality traits were less evident during 7th and 9th grades and increased after 10th grade. Shen, Wang, and Shi (2005) used a self-created creative tendency chart to study 476 students in 5th, 6th, 7th, 8th, 10th, and 11th grades in Beijing, China. The results indicated a general upward trend with rising grade level and an inverted V-shaped curve in creative tendencies in adolescence. Creative tendencies were the greatest in the 5th to 7th graders and then dropped to a low in 11th grade. Studies in the United States indicated an upward trend in adolescent creative tendencies with grade level. However, the study results in Korea and China indicated that creative tendencies in adolescent students after middle school based on self-made assessments showed a downward trend, possibly related to the high school teaching environment in Korea and China, which is widely affected by credentialism.

1.3. Impact of social changes on development of creativity

Scores on intelligence tests evidently increase year after year (Cattell, 1950; Tuddenham, 1948). Flynn (1984, 1987) analyzed intelligence test data collected in the United States and fourteen other developed countries from various years and reported that the average intelligence score increased approximately 0.17–0.83 points per year in each country from 1932 to 1978. Herrnstein and Murray (1994) subsequently referred to this phenomenon as the Flynn effect. Chen, Chen, Liao, and Zhu (2011) analyzed the Wechsler Intelligence Test scores of students from various age groups between 1997 and 2007 in Taiwan and confirmed the overall presence of the Flynn effect. The cause of the Flynn effect is complex such that scholars have not arrived at a clear consensus. Genetics, nutrition, health, family structural changes, and various other factors such as social and educational advances may affect one another (Flynn, 2006; Mingroni, 2007; Schooler, Mulatu, & Oates, 1999). Creativity has been regarded as overlapping with intelligence to a certain extent but different in psychological constructs. Does the Flynn effect also play a role in creativity? Kim (2011) compared the TTCT scores from different years and found that between 1968 and 2008, almost all the subscale scores decreased significantly except those of resistance to premature closure, which increased significantly. If the subscale scores from the latest 10 years are compared, only that of originality increased, whereas all the other scores decreased significantly. Kim (2011) presented a great deal of discussion and many assumptions in his dissertation, which was based on a sample of more than 270,000 subjects. Kim concluded that education in the United States has changed from being successful in encouraging creativity in children to implementing standardized testing and is even adopting national educational standards (Lewin, 2010; July 21). In contrast, countries such as China, Japan, Korea, and Taiwan have modeled their educational systems on the American educational system and have placed more emphasis on creativity (Kim, 2011).

In recent years, due to demands from business and economic development, mainland China, Hong Kong, Singapore, and Taiwan have begun to encourage and implement creative education. Taiwan has the highest input of resources, particularly from non-government organizations under executive coordination between industry and the government (Hui & Lau 2010). To foster national competitiveness and the overall quality of life, the Ministry of Education of Taiwan promoted educational reform. In 2000, the MOE set curriculum goals including the following: “To develop creativity”, “To develop abilities related to independent thinking and problem solving”, and “To acquire the ability to utilize technology and information” in the “general guidelines of the grade 1–9 curriculum of elementary and junior high school education” (The Ministry of Education of Taiwan, 2001). In addition, Taiwan has an official document, the White Paper on Creative Education, published in 2003. Multiple levels of creativity development have been discussed in Taiwan to foster creativity in educational activities at all grade levels through gradual implementation (Chang et al., 2013). However, Hui and Lau (2010) noted that among mainland China, Hong Kong, Singapore, and Taiwan, none have used standardized creativity tests to identify creative students or evaluate the efficacy of creative education. Therefore, there are still questions that are unanswered. After 10 years of hard work, will the educational system in Taiwan adequately promote student creativity, or will it resemble the American system, where creative performance has worsened? Before these questions can be answered, a study involving a large sample is needed. This study can not only help us explain the developmental trend of creativity from both individual and societal standpoints but can also serve as a valuable reference for the implementation and promotion of creative education.

2. The present study

The goal of the present study was to investigate and analyze creative development trends in adolescents in Taiwan and to compare the findings with the creative development situation prior to the active promotion of creative education by the government. The adolescents involved in the present study were students in late elementary to senior high school. Many studies have stressed the importance of both cognitive and affective processes in creative behavior (Houtz & Krug, 1995;
Treffinger, Isaksen and Firestein, 1983). From an educational standpoint, the situation where student's creativity is easily changed due to intervention of educational environment reflects the characteristics of cognitive thinking and emotional tendencies (Houtz & Krug, 1995; Simonton, 2012; Treffinger et al., 1983; Williams, 1969).

Because divergent thinking is the most commonly used index in evaluating creative cognition potential, as proposed by Guilford (1956, 1977, 1988), many studies have relied on divergent thinking to assess creativity (e.g., Furnham, Batey, Anand, & Manfield, 2008; Kaufman, Plucker, & Baer, 2008; Plucker & Makel, 2010; Silvia et al., 2008; Silvia, Nusbaum, Berg, Martin, & O'Connor, 2009). Although divergent thinking is not a perfect proxy for creativity, the specific operational definition of divergent thinking enables us to make reliable measurements of creative thinking (Runco & Acar, 2012). Tests of divergent thinking are appropriate for surveying large groups with good reliability and validity. In addition, tests of divergent thinking have made a unique contribution to identifying creative potential (Plucker & Renzulli, 1999; Runco & Acar, 2012; Runco & Albert, 1985; Vincent, Decker, & Mumford, 2002) and thus are useful in defining the cognitive potential of creativity (Runco & Acar, 2012). Many tests have been compiled based on the concept of divergent thinking (Hocevar, 1981; Zeng, Proctor, & Salvendy, 2011). There are generally four indices used to measure divergent thinking: (1) fluency, i.e., the number of responses provided by the test subject; (2) flexibility, i.e., the number of types of responses the subject generated; (3) originality, i.e., the number of unique responses the subject generated, usually measured statistically based on the occurrence frequency; and (4) elaboration, i.e., the elegance and refinement of the subject's responses.

In contrast, Williams (1969) proposed a cognitive-affective creativity model in which divergent feeling is used to measure creative performance from the affective perspective. Divergent feeling is the attitude, motivation, interest, and mood expressed by an individual when performing divergent thinking (Hsiao, 2014; Edwin, Emily, & John, 2005; Maddux & Galinsky, 2009). Divergent feeling has several aspects: curiosity, imagination, risk-taking, and complexity. Curiosity is an individual's eagerness in pursuing an answer when having question or doubts while continuing to think, investigate, ask, and be unafraid of difficulties in order to understand the ultimate truth. It is a key feature of questioning and brainstorming. Imagination is the quality of mind of using instincts to speculate and conceive of and visualize various images when brainstorming about questions beyond reality with unlimited possibilities. Risk-taking is the quality of having an exploratory spirit in guessing, trying, and experimenting or being actively receptive to criticism or failure face-to-face but still able to persevere while remaining confident of one's opinion and handling unknown situations. Complexity refers to the ability to find a solution when handling complex question or chaotic opinions. An individual with this trait will apply logic in a complex situation without feeling stress and will pursue numerous possibilities to identify key issues and handle problems in an organized way. This connotation has overlapped in the creative personality and affective constructs of many researchers (Basadur & Hausdorf, 1996; Kumar, Kemmler & Holman, 1997; Rimm & Davis, 1980; Rookey, 1973) and is therefore appropriate for use as an index of creativity and its affective dimension.

From childhood to adolescence, cognitive development transitions from the concrete operational stage to the formal operational stage. Will creative cognition in students be impacted during this transitional stage and thus decline, or will it increase with time because of factors such as intelligence and learning experiences? Will students in childhood and adolescence who are developing self-identities be more willing to participate in creative activities, or due to the enormous pressure of admission entrance exams in high school, will students become less willing to participate in creative activities and spend more time preparing for exams? Finally, will creative performance be enhanced by efforts of the Taiwan government and non-government groups to promote creative education, the openness of Taiwan's social democracy, and the correlation between the Flynn effect and intelligence in Taiwan reported by Chen et al. (2011). To address these questions, the following research questions were posed at the outset of the present study:

1. Does divergent thinking in adolescence in Taiwan trend downward in adolescence after peaking in 6th grade, or is the trend upward starting in 6th grade and extending through adolescence?
2. Does divergent feeling in adolescent students in Taiwan trend upward with rising grade level, or does it begin to decrease in middle adolescence and exhibit a V-shaped trend?
3. Is there an upward trend in creative developmental in the previous 20 years in Taiwan?

3. Methods

3.1. Participants

In this study, a portion of the participant data was taken from the series of studies performed by the second author (Chang, Su, & Chen, 2015; Chang, Chen, Hsu, Chan, & Chang, 2015; Chang, Hsu, Shih, & Chen, 2014), which included 982 students in 5th, 6th, 7th and 9th grades in Taiwan. The remaining participant data were taken from a study of 692 high school students in 7th through 11th grades in Taiwan by the first author in 2014 and 2015. The number of participants in the present study totaled 1674 students. The participants were selected from different geographic regions in Taiwan. The classes were the primary cluster sampling units. Urban schools were accounted for 44%, and suburban or rural schools were accounted for 56%. Sixty-three percent of participants was from western region of Taiwan, where was a more economically developed area. Thirty-seven percent of participants was from east region of Taiwan, where was less economically developed. The number of participants and the gender ratio in each grade are as follows (Table 1):
3.2. Measures

This study used the New Tests of Creative Thinking to assess the young adolescents’ divergent thinking as an index of creative cognition potential. We also used the scores from the Test of Divergent Feeling in the Creativity Assessment Packet (CAP) as an index of creative affect potential. To compare across years, we used the mean and standard deviation of the norm for adolescents from both the New Tests of Creative Thinking developed by Wu et al. (1999) and the test of Divergent Feeling developed by Lin and Wang (1994) to represent the creative performance of Taiwanese adolescents in the past.

3.2.1. New tests of creative thinking

The New Tests of Creative Thinking conducted by Wu et al. (1999) was based on the Torrance Tests of Creative Thinking (Torrance, 1974) and modified for a Chinese version, and has been widely used in Chinese society for identifying creative students (Wu & Albanese, 2010). This test consisted of two tasks: verbal creativity task (Unusual uses of chopsticks) and figural creativity task (to draw a Chinese character ‘人’). The researchers used this figural creativity task rather than verbal based test because previous studies revealed that figural creativity task has been shown to be less biased in terms of language and verbal ability (Kim, 2006; Torrance, 1977).

Figural creativity task measured the figural aspect of creative thinking with four indices: fluency, flexibility, originality, and elaboration. The score of fluency was calculated by following formation: total responses minus the repeated or irrelevant ones. The score of flexibility was calculated by referring to the category indices in instruction manual, and each category had its own credit. The score of originality was counted by referring to the norm in the manual, and each response was scored from 0 to 2. Elaboration was identified by the number of figural decorative items to the Chinese character ‘人’ One item credited one point. Each task took approximately 10 min.

As for reliability and validity, analyses based on 2300 participants across different developmental stages (from children to adults) showed that each creativity index (e.g., fluency) was correlated positively with the Torrance Creativity Thinking Test- Figural (rs = 0.39–0.75, ps < 0.001; Wu et al., 1999). In the present study, three independent raters, blind to the participant’s background, provided highly consistent ratings across all indices (rs = 0.90–0.98, ps < 0.001). This study did not include elaboration scores due to the subjectivity of elaboration scores and lower correlation with other criterions.

3.2.2. Creativity assessment packet (CAP)

The CAP was created by Williams (1980) to assess creativity in cognitive and affective aspects. The Test of Divergent Feeling in the Creativity Assessment Packet (CAP) was administered to assess the participants’ affective aspect of creativity. The Test of Divergent Feeling consisted of four categories: curiosity (13 items; e.g., I would like to know what other people think), imagination (13 items; e.g., If the final page of a storybook is missing, I will make up the story’s ending myself), complexity (12 items; e.g., I like unusual things), and risk taking (12 items; e.g., Trying a new game or activity is an interesting thing). Each item is scored on a 3-point Likert scale. The Chinese version created by Lin and Wang (1994) established its good internal consistency (Cronbach’s αs = 0.77–0.88) and test–retest reliability for young adolescents after three months (rs = 0.49–0.81, ps 0.001), and showed good predicted value for identifying creative students. The studies of Chan, Chen, & Lavallee (2013) and Chang, Chen et al. (2015), Chang, Su et al. (2015) revealed good reliability and validity in Chinese participants.

4. Results

First, we tested for grade differences on three indices of divergent thinking and four indices of divergent feeling using multivariate analysis of variance (MANOVA). Then, we used one-way ANOVA to analyze each index with grade as an inter-subjective factor combined with trend analysis to analyze the developmental trend at each grade level. For the significance thresholds of each univariate analysis, the three indices of divergent thinking were set to p < 0.05/3 = 0.016. The four indices of divergent feeling were set to p < 0.05/4 = 0.012. Tukey HSD tests were applied for post-hoc analysis of group-to-group comparisons. Finally, we compared the results to the mean of the norm for adolescents in both the New Tests of Creative Thinking developed by Wu et al. (1999) and the test of Divergent Feeling developed by Lin and Wang (1994). We used the t-test to analyze the differences between the scores of the present study (2014–2015) and the norm in the past at each grade level.
Table 2
Means and standards deviation of the Divergent Thinking and Divergent Feeling by grade levels.

<table>
<thead>
<tr>
<th>Grade 5 (N=237)</th>
<th>Grade 6 (N=120)</th>
<th>Grade 7 (N=245)</th>
<th>Grade 8 (N=429)</th>
<th>Grade 9 (N=190)</th>
<th>Grade 10 (N=296)</th>
<th>Grade 11 (N=157)</th>
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<td></td>
<td>M</td>
<td>SD</td>
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<td>SD</td>
<td>M</td>
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<tr>
<td>Divergent thinking</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Figural fluency</td>
<td>11.33</td>
<td>5.34</td>
<td>11.84</td>
<td>4.88</td>
<td>11.91</td>
<td>5.87</td>
</tr>
<tr>
<td>Figural flexibility</td>
<td>7.75</td>
<td>2.95</td>
<td>8.28</td>
<td>2.84</td>
<td>7.79</td>
<td>3.54</td>
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<tr>
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<tr>
<td>Risk-taking</td>
<td>2.23</td>
<td>0.28</td>
<td>2.17</td>
<td>0.25</td>
<td>2.24</td>
<td>0.29</td>
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<td>Curiosity</td>
<td>2.27</td>
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<td>2.25</td>
<td>0.34</td>
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<tr>
<td>Complexity</td>
<td>2.07</td>
<td>0.39</td>
<td>1.95</td>
<td>0.35</td>
<td>2.08</td>
<td>0.35</td>
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<tr>
<td>Imagination</td>
<td>2.26</td>
<td>0.27</td>
<td>2.19</td>
<td>0.24</td>
<td>2.25</td>
<td>0.26</td>
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Fig. 1. Total figural fluency, figural flexibility, figural originality by grade level.

4.1. Difference and developmental trend of divergent thinking and divergent feeling measures by grade level

Means and standard deviations of divergent thinking and divergent feeling measures were presented in Table 2. The developmental trend of total divergent thinking indices (figural fluency, figural flexibility, figural originality) by grade levels were displayed in Fig. 1. The developmental trend of total divergent feeling indices (risk taking, curiosity, complexity, imagination) by grade levels were displayed in Fig. 2.

4.1.1. Divergent thinking

All participants were divided into seven groups from the fifth to the eleventh grade. MANOVA was used to examine three indices of Divergent Thinking: figural fluency, figural flexibility, and figural originality. In general, the results showed that these three creative thinking indices had a significant difference among grade levels (Wiiks’ A = 0.91, F(18, 4709.82) = 8.45, p < 0.001, $\eta^2 = 0.030$). ANOVA, trend analysis, and Turkey HSD tests (Post-Hoc) were then used to analyze figural fluency, figural flexibility, and figural originality.

The scores of figural fluency had a significant difference by grade levels ($F(6, 1667) = 12.16, p < 0.001, \eta^2 = 0.042$). Overall, the linear trend showed a significant increase ($F(1, 1667) = 64.19, p < 0.001$), but the nonlinear trend did not show its
significance. Post-Hoc analysis showed that there was no significant difference from the fifth and sixth grades (elementary level) to the seventh grade (junior high level). The scores of two grades increased significantly: 1) The eighth grade had a significant increase compared to the fifth grade \( (p = 0.001) \); 2) The tenth and eleventh grades (senior high level) had a significant increase and the tenth grade were higher than the ninth grade \( (p = 0.042) \).

The scores of figural flexibility had a significant difference by grade levels \( (F(6, 1667) = 18.30, \ p < 0.001, \ \eta^2 = 0.062) \). The linear trend also showed a significant increase from the fifth to the eleventh grade \( (F(1, 1667) = 78.01, \ p < 0.001) \). The nonlinear trend also showed its significance \( (F(1, 1667) = 17.01, \ p < 0.001) \). But the linear trend was the best fitting model. Post-Hoc analysis showed there was no significant difference from the fifth grade (elementary level) to the ninth grade (junior high level). The tenth grade (senior high level) started to ascend steeply and was significantly higher than the ninth grade \( (p < 0.001) \). As a whole, the developmental trend ascended as grades increased and was displayed as a pattern similar to a J-shaped curve.

The scores of figural originality had a significant difference by grade levels \( (F(6, 1667) = 7.37, \ p < 0.001, \ \eta^2 = 0.026) \). As a whole, the linear trend showed a significant increase from the fifth to the eleventh grade \( (F(1, 1667) = 37.44, \ p < 0.001) \), but the nonlinear trend did not show its significance. The linear trend was the best fitting model. Post-Hoc analysis indicated there was no significance among grade levels. The scores of the sixth grade and above were displayed as an ascending trend year by year.

### 4.1.2. Divergent feeling

MANOVA was applied to examine four indices, risk-taking, curiosity, complexity, and imagination of divergent feeling in the fifth- to eleventh-grade students. The results indicated that the scores of four indices had a significant difference by grade levels \( (Wilk's \ \Lambda = 0.88, \ F(24, 5806.21) = 8.42, \ p < 0.001, \ \eta^2 = 0.029) \). ANOVA, trend analysis, and Turkey HSD tests (Post-Hoc) were then used to analyzed risk-taking, curiosity, complexity, and imagination.

The scores of risk-taking had a significant difference by grade levels \( (F(6, 1667) = 5.72, \ p < 0.001, \ \eta^2 = 0.020) \). The linear trend showed a slight increase from the fifth to the eleventh grade. The linear trend reached a significant level \( (F(1, 1667) = 4.541, \ p = 0.033) \). The quartic trend was more evident \( (F(6, 1667) = 25.28, \ p < 0.001) \), which indicated that the risk-taking was changing. Post-Hoc analysis showed a pattern from the fifth grade (elementary level) to the eleventh grade (senior high level). The scores of the sixth and the tenth grades were lower than other grades. The score of the sixth grade was at the lowest point, significantly lower than the eighth grade \( (p = 0.17) \), the ninth grade \( (p = 0.025) \) and the eleventh grade \( (p < 0.001) \). The scores of the tenth grade were at the second lowest point, significantly lower than the eighth and the eleventh grades \( (p < 0.001) \) which were at higher points. An entire developmental trend displayed as a W-shaped curve.
The scores of curiosity had a significant difference by grade levels ($F(6, 1667) = 7.01, p < 0.001, \eta^2 = 0.025$. 5). The linear trend showed a significant increase from the fifth to the eleventh grade ($F(1, 1667) = 16.20, p < 0.001$). The quartic trend was also significant and provided the same results as the risk-taking ($F(4, 1667) = 17.94, p < 0.001$). Post-Hoc analysis demonstrated that the score of the sixth grade was at the lowest point and had a significant difference compared to other grades ($ps < 0.001–0.025$), except the seventh grade. The score of the eleventh grade had a significant increase and was higher than other grades (all $ps < 0.001$). An overall developmental trend also was displayed as a W-shaped curve.

The scores of imagination had a significant difference by grade levels ($F(6, 1667) = 24.62, p < 0.001, \eta^2 = 0.081$). The linear trend showed a significant increase from the fifth to the eleventh grade ($F(1, 1667) = 41.04, p < 0.001$). The quartic trend also exhibited significance ($F(1, 1667) = 16.68, p < 0.001$). Post-Hoc analysis demonstrated that the score of the sixth grade was at the lowest point and significantly lower than other grades ($ps < 0.001–0.002$). There was no significant difference from the seventh grade to the tenth grade. The score of the eleventh grade had a significant increase and was higher than other grades (all $ps < 0.001$). The entire developmental trend was displayed as a skew V-shaped curve.

The scores of complexity had a significant difference by grade levels ($F(6, 1667) = 11.55, p < 0.001, \eta^2 = 0.040$). The linear trend showed a significant increase from the fifth to the eleventh grade ($F(1, 1667) = 90.87, p < 0.001$). The quadratic trend ($F(1, 1667) = 17.70, p < 0.001$) and the quartic trend ($F(1, 1667) = 34.00, p < 0.001$) also exhibited significance. Post-Hoc analysis demonstrated that the score of the sixth grade was at the lowest point and significantly lower than other grades ($ps < 0.001–0.027$). The score of the eleventh grade had a significant increase and was higher than other grades (all $ps < 0.001$). The whole developmental trend was displayed as a skew V-shaped curve.

4.2. The difference of divergent thinking and divergent feeling in recent 20 years in Taiwan

The two mean scores of adolescent norms established in The New Tests of Creative Thinking by Wu et al. 1999 and Divergent Feeling by Lin and Wang (1994) represented student creativity potential before creativity education was promoted in Taiwan. The scores collected from 2014 and 2015 in this study were the representatives of creativity education popularized in Taiwan.

Three studies had different age ranges for sampling. In Wu et al.’s study, the norm included participants from grade 5 to graduate level without grade 9 and 12. In Lin and Wang’s study (1994), the norm comprised of students from grade 5 to 12. The researchers in this study selected six grades, including 5th, 6th, 7th, 8th, 10th, and 11th grades, which were overlapped among these three studies. In addition, the sampling of all studies focused on Taiwanese schools. However, the percentages among different areas as well as among different geographic regions were not the same. In the sample collected from 2014 to 2015, participants in urban and rural areas were accounted for 44% and 56%, and students in western and eastern regions were separately accounted for 63% and 37%. The norm in Wu et al.’s study (1999) included 88% of the participants in urban schools and 12% in rural schools, showing significantly different from the 2014–2015 sample ($\chi^2 (1) = 3499.73, p < 0.001$). All students were from the western region (no eastern region data), also significantly different from the 2014–2015 sample. In Lin and Wang’s study (1994), the urban schools were accounted for 50% as well as rural schools, showing significantly different ($\chi^2 (1) = 26.75, p < 0.001$), and the school percentages with 78% from western regions, 22% from eastern regions ($\chi^2 (1) = 173.06, p < 0.001$). Compared to the past, in general, more participants were recruited from rural areas and eastern region (remote areas) in the 2014–2015 sample.

The means and standard deviations of divergent thinking and divergent feeling measures in different eras were presented in Tables 3 and 4. The difference in each index of divergent thinking and divergent feeling measures in different eras were illustrated in Figs. 3–9.


As Table 3 and Table 4, figural fluency, figural flexibility, and figural originality in 1998 had a similar developmental trend. The scores of the fifth to the seventh grade had a significant increase, the eighth grade had a slump, and the tenth grade in senior high level increased. The scores of the eleventh grade was slightly decreased different from the scores in 2014–2015. The means of figural fluency of the seventh grade in 2014–2015 was significantly lower than it in 1998. However, the figural fluency of the eighth and the eleventh grade in 2014–2015 was significantly higher than it in 1998. With regard to figural flexibility, the score in seventh grade in 2014–2015 was significantly lower than it in 1998. The figural flexibility of the eleventh grade in 2014–2015 was significantly higher than it in 1998. Concerning the figural originality, the scores of the fifth, the eighth, and eleventh grade were significantly higher than it in 1998, and the scores of other grades were not significantly different from the scores in 1998.

4.2.2. Divergent feeling between 1994 and 2014–2015

The development trend of divergent feeling in 1994 was similar to it in 2014–2015. The divergent thinking had no significant difference by grade levels as well as no slump in the sixth grade and no steep ascending in the eleventh grade. Except the imagination score of the sixth and seventh grade, the means of grade levels in 2014–2015 were significantly enhanced than any other scores in 1994 ($ts = 3.40–19.66$, all $ps < 0.001$).
Fig. 3. Figural Fluency by grade level for Years 1998, 2014–2015.

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>2014-2015</th>
<th>1998 norm</th>
</tr>
</thead>
<tbody>
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<td>Grade 6</td>
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<td>Grade 7</td>
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<td>Grade 11</td>
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Fig. 4. Figural Flexibility by grade level for Years 1998, 2014–2015.

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<td>Grade 11</td>
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Fig. 5. Figural Originality by grade level for Years 1998, 2014–2015.

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Table 3

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</table>

Note. In the norm of The New Tests of Creative Thinking (Wu et al., 1999), the means and standard deviations of the ninth grade were not provided. Thus, the comparison was not presented. *p < 0.05.
**p < 0.01.
***p < 0.001.

Table 4
Means and Standard Deviations of the Subscale Scores on the Exercise in Divergent Feeling for Years 1994 (norm), 2014–2015 (present study) and t-test.

<table>
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<th>t-test</th>
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<td></td>
<td>11</td>
<td>226</td>
<td>1.99</td>
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</table>

***p < 0.001.

5. Discussion

5.1. Developmental trend of divergent thinking

The results indicated that figural fluency in divergent thinking in 5th through 7th grades did not trend upward but did increase with each grade level from 8th through 11th grades. Figural flexibility in 5th through 9th grades did not differ
significantly but did begin to increase during 10th and 11th grades. Figural originality, except for small fluctuations during 5th through 7th grades that decreased initially and then increased, slowly increased and then peaked in 11th grade. The gradual increase beginning in 5th grade indicated that, empirically, the transition from one stage of cognitive development to the next does not have a negative impact on the development of divergent thinking. The overall results are not consistent with the results of American studies such as those of Camp (1994) and Kim (2011), who reported a decline after 6th grade. However, the data collected by Camp (1994) dated back to the 1970s, and the grade comparison data from Kim (2011) were merged from 40 years ago, starting from the 1960s, which could differ from the recent data used in our study due to changes with time. Our results are inconsistent with those of Lau and Cheung (2010), although both studies involved Asian students. We did not observe a significant drop during 5th through 7th grades, when elementary students are transitioning into high school, as Lau and Cheung (2010) reported. No specific interpretation of the 7th-grade slump was presented by Lau and Cheung. Interestingly, however, an 8th-grade slump was evident in our results after making the comparison with the norm trends (see Figs. 3–5) of 1998 based on the New Tests of Creative Thinking, the assessment instrument used in the present study. Therefore, several questions arose: What explains the difference between the findings in Taiwan and Hong Kong? Was it due to the different tools that were used? We used the New Tests of Creative Thinking, whereas the new computerized Wallach-Kogan creativity tests were used in the Hong Kong study. Was the difference due to different creative education policies promoted in Taiwan and Hong Kong? Further studies are needed to answer these questions. However, these inconsistent results also refer that the development of creative cognition from childhood to adolescence does not necessarily have biological universals as similar to the Piaget’s theory of cognitive development. The social factors

Fig. 6. Risk-taking by grade level for Years 1994, 2014–2015.

Fig. 7. Curiosity by grade level for Years 1994, 2014–2015.
may interact its development simultaneously. The developmental trend after 7th grade observed in the present study is consistent with the results of other recent studies, such as those of Claxton et al. (2005), Kleibeuker et al. (2013), Lee and Choi (2012), and Lau and Cheung (2010). All show a general upward trend as with rising grade level, indicating that the local developmental trend in creative potential in adolescence may overtake the trends in other cultures in Europe, the United States, and Asia overall.

5.2. Developmental trend in divergent feeling

The results of our study revealed that 4 of the subscale scores on the test of divergent feeling generally showed a linear upward trend. The 6th graders scored the lowest on the subscales, and the 11th graders scored the highest, which suggests that supporting adolescents through increasing self-awareness and self-recognition can boost their confidence to do creative activities and generate ideas of creative motivation (Allison & Schultz, 2001; Claxton et al., 2005; Erickson, 1963; Rothenberg, 1990). The findings of both the present study and the longitudinal study of Claxton et al. (2005) were consistent in that the divergent feeling in 6th through 9th grades showed a steep upward curve. Claxton et al. (2005) believed that because students in 6th through 9th grades are growing into adolescence, the change in divergent feeling should be viewed as a noncognitive factor in creativity, as suggested by Cropley (2003). Claxton also believed that divergent feeling is related to creative motivation, which will continue to develop during adolescence. However, our results differed from findings in Korea (Lee & Choi, 2013) and Beijing (Shen et al., 2005). Shen et al. (2005) suggested that the decrease in divergent feeling in high
school students is due to a decline in their idealism: as they grow in experience and knowledge, high school students come to resemble adults, whose creativity has become impoverished. Shen et al. (2005) also mentioned the pressure of test-taking that high school students experience, which is prevalent in East Asia but not as much in Europe and America. Interestingly, such a phenomenon was not observed in the Taiwanese students. In addition to the use of different assessment tools, does the pressure observed in Korea and China from the highly competitive environment explain the drop in divergent feeling in students right after starting high school (Cai & Zhu, 2007). Instead, does the open educational environment in Taiwan explain the sustained creativity of the Taiwanese high school students? There are still no studies of divergent feeling across East Asia, and further research is warranted.

5.3. **Comparison of divergent thinking and divergent feeling with historic norms**

The results of the present study indicated that the developmental trend in divergent thinking was generally smoother in the 2014–2015 period than in 1998: the 7th graders in 2014–15 did not display a significant increase as in 1998, the 8th graders did not exhibit a steep drop as in 1998, and the 11th graders did not exhibit a steep decrease as in 1998 but instead presented an increase. Figural originality was the only category in which more age groups improved in 2014–2015 versus 1998. The scores of figural fluency and figural flexibility in both 2014–2015 and 1998 were level. In comparisons of the developmental trends in divergent feeling in 2014–2015 and 1994, the former, except for a significant trough in 6th grade, was generally the same as the latter. However, almost all the 4 subscale scores in 2014–2015 were significantly higher than those in 1994. These significantly higher scores partially supported the hypothesis of the study: between 1994 and 2014, significant growth occurred in the figural originality of divergent thinking of the Taiwanese students in childhood and adolescence.

According to Chang, Su, and Chen’s study (2015), adolescent’s socioeconomic status was positively correlated with their creative thinking in Taiwan. In other words, adolescents with lower socioeconomic status may have lower levels of creative thinking. However, the result in this study showed that participants with lower socioeconomic status had higher scores or no significant difference in both tests of divergent thinking and divergent feeling, even though more participants were recruited from rural areas than previous studies. The trend was strongly confirmed that contemporary students have higher creativity than students in the past.

Maker et al. (2008) noted that development of creativity is supported when active learning, student choice, access to varied materials, exploration, self-evaluation, problem finding, and problem solving are stressed in the educational environment, and these factors have been key in promoting creative education in Taiwan in the past. In addition to having an official document, the White Paper on Creative Education published in 2003, Hui and Lau (2010) believed that the creative education policy in Taiwan also includes the multiple levels of creativity development (individual, school, social, industrial, and cultural) that have been discussed in Taiwan. Taiwan has the highest input of resources, especially from non-government organizations under the executive coordination between industry and the government. Kuo and Wu (2008) studied teachers who participated in the Local Creative Education project; almost every teacher agreed that participating in the creativity project helped improve their teaching, the creative design of their classes, the school climate, and the students’ interests in creativity. As noted by Wu and Albanese (2013) in a review of the outcome of programs to promote creative education in Taiwan, while the reality has yet to meet expectations, the climate in schools has encouraged an initial flourishing of creativity. These conditions most likely explain the upward trend in the creative developmental in children and adolescents in Taiwan from 1994 or 1998 to 2014–2015. However, this creative education in Taiwan uses a bottom-up approach to improve and promote student creativity in an implicit educational environment, which could explain the lesser growth in divergent thinking from the cognitive perspective. Scott, Leritz, and Mumford (2004) conducted a meta-analysis of 70 papers on creative training and teaching and found that overall, technical thinking training could promote creativity better and that attitude or behavior are not as effective in enhancing creativity. Scott et al., 2004 believed that effective creativity training must (1) engage cognitive skills on a long-term basis in various ways, (2) be supplemented with real-life examples, and (3) include activities applicable to the user’s relevant areas to provide user with application strategies.

In addition, the rapid advancement of technology and internet makes people more easily access diverse and a large amount of information when living in the environment with fast changes. An increasingly open society and democratization in Taiwan over the past two decades have an impact that people are able to accept diverse opinions, and further appreciate various kinds of creative activities. Therefore, these environmental factors might influence students’ divergent feeling. This trend similarly refer to Csikszentmihalyi’s opinion on changes in society where the creative motivation could be increased depending on what “gatekeepers” do.

5.4. **Conclusions**

We collected and merged a large amount of data to form a large sample. By comparing the data to the norm built by previous assessments, we not only could discover the trend of contemporary students’ creativity development at different educational levels, but also could investigate the change of creativity potentials and affective characteristics in different eras. The results could be referred to the related education-policy review and improvement, and fill the gap in this research field.

We observed an overall linear increase in creativity potential and tendencies during childhood and adolescence among students in Taiwan, both from the cognitive and affective perspectives. The result in this study was not similar to previous
studies which showed the phenomenon of creativity slump during childhood and adolescence. (e.g. Chae, 2003; Charles & Runco, 2001; Cheung et al., 2004; Kim, 2011; Lopez et al., 1993; Lubart & Lautrey, 1995; Urban, 1991). In both cognitive or affective aspects, creativity development is highly influenced by societal culture without universals across eras and cultures. In addition, when comparing present-day students to those in 1994–1998, divergent thinking generally displays an upward trend. When evaluating the scores on divergent feeling, the differences lie on the enhancement of overall scores. It suggests that societal change has different impacts on divergent thinking and divergent feeling during childhood and adolescence.

Essential points for the results of this study are as follows. First of all, in divergent thinking, it is noteworthy that only figural originality increased significantly. When Kim (2011) compared the TTCT scores from the period of 1998–2008, originality increased, whereas all other scores dropped significantly. Kim suggested that the calculated scores of originality relied heavily on the norm established many years ago, which had been invalid. This explanation of inflated scores due to the consideration of rare responses to many popular modern terms or concepts were first proposed by Wu et al. (1999). Second, we did not perform a longitudinal study but instead using a cross-sectional method, which, when studying differences across grade levels, limits the reliability of the grade differences (Kleibeuke et al., 2013). Moreover, there are numerous dimensions of creativity. The most commonly used indices, divergent thinking and divergent feeling, were used in the present study, although there are many other indices worthy of investigation and comparison in subsequent studies.

Further study is needed to clarify whether the differences from one region to the other, particularly among Korea (Lee & Choi, 2012), mainland China (Shen et al., 2005), and Hong Kong (Lau & Cheung, 2010), are due to the use of different tools, or resulting from social, cultural, and educational environment factors. Before we can determine if the study results support the effectiveness of the promotion of creative education in Taiwan during the previous decade, a more detailed study with more variables and better control is warranted. Finally, the findings suggest that creative thinking techniques should be integrated into curricula, and teachers should be provided with more training and development in creative thinking. Teachers could then inspire students to apply creative thinking to more complex but real situations.

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