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Correlates of creativity and elementary school students' perceptions of individual and sociocultural factors

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Abstract

The study investigated the relationships between individual and sociocultural factors and students' creativity based on a sociocultural perspective. The participants are 7,324 fifth graders from 242 schools obtained from the Korean Educational Longitudinal Study 2013. Through multilevel modeling, student gender, self-regulation behaviors, academic achievement, extrinsic motivation, and perceived parenting style at level 1, and school characteristics such as teacher's teaching methods, students' relationship with their teacher, and their teacher's academic pressure at level 2 were incorporated. The final model incorporating both level 1 and level 2 variables showed that the most significant variable related to students' creativity was self-regulation, followed by peer attachment, academic achievement, gender, relationship with their parents, academically supportive parenting style, and relationship with the teacher in the order listed. It is assumed that creativity is supported not only by elementary school children's cognitive ability but also by sociability in school, especially with peers.

Keywords: creativity, cognition, parenting style, teacher's academic pressure

Introduction

Creativity is often defined as generating something new, regardless of the domain in which creativity is manifested. More specifically from the cognitive perspective, it refers to when one solves a problem in a different way from existing methods or when one verifies

usability by applying existing knowledge to a new area (Sternberg & Todd, 1996). Because of its novelty and usability, creativity received lots of attention across various domains such as arts, sports, academia, and even in everyday life. Although its fancy features that the word, creativity, renders, it seems that it is not an easy task to measure its construct and trace its emerging mechanism. Researchers have actively conducted to identify factors that can measure creativity and related factors, but there are indeed no definitive factors that can solely explain creativity. This is because, including the personal dimension, various factors in the social context interacting with each other constitute creativity and influence the development of creativity (Barbot et al., 2011; Moruzzi, 2021).

Over the past quarter of a century, South Korea has prioritized creativity in the classroom as the bedrock for success amid the uncertainties of the modern world; to date, however, the results have been below the expectations raised by the rhetoric (So et al., 2017). This has inevitably raised the question of what factors have been correlating with the successful introduction of creativity into the curriculum.

Given creativity as an abstract concept, it is often defined as measuring its constructs themselves (Csikszentmihalyi, 1999; Kharkhurin, 2014; Woodman, 1981). Efforts have been extended to understanding how the creative attitude is influenced by an individual's cognition, attitude, and environmental factors surrounding the individual. First, aligned with its relation to cognition, it was found that creativity has a high correlation with intelligence. However, it seems that creativity itself does not require high intelligence only. Renzulli (2016) argues that creativity emerges from gifted individuals with normal intelligence when combined with persistence. In addition, the definition of creativity is heavily influenced by cultural variation (Glăveanu, 2010; Kharkhurin & Yagolkovskiy, 2021; Lubart & Sternberg, 1998), which means that creativity is

differently interpreted in different cultures. Because of its nonlinearity and multilayered characteristics, research on creativity needs to consider a broader but structured approach to its underlying nature. Bronfenbrenner (1974) early argued an ecological framework, in which individuals interact with various ecosystems surrounding them. Especially for students, the school culture as a social system has a great impact on the students' creative attitude including the most intimate home ecological system (Kupers & van Dijk, 2020), not to mention the individual's innate traits. Each of these ecological systems inevitably interacts with and influences each other for all aspects of the student's lives and their creative attitudes. There is a rich body of research investigating the interrelationships between individual and sociocultural factors and their influence on individual creativity. However, the sociocultural factors used in most previous studies were quite frequently measured without considering how individuals perceived them (Dong et al., 2022; Fearon et al., 2013; Jankowska & Gralewski, 2022). For example, parenting styles were obtained from parents' responses about their behaviors or attitude rather than how the children perceive the parent's behaviors. Parents' reflective reports may be distorted and perceived differently from what was intended. It is necessary to investigate students' creativity with various individual and sociocultural factors from the student's perspective. In this study, it was differentiated the influences of individual, home, school, and sociocultural characteristics and explored how various factors correlate with students' creativity from the student's perspective.

Intra-individual aspects of creativity

1. Self-regulation

Researchers who see creativity from a cognitive perspective have noted that creativity as an individual competence can be measured through experimentation or a psychometric approach. It was proposed earlier that creativity was related to cognitive ability, such as divergent thinking (Guilford, 1950, 1967), associative thinking (Mednick, 1962), analytical thinking (Sternberg et al., 2005), flexibility in thinking (Kenett et al., 2018), originality (Runco, 1988), elaboration for segmenting (Mainemelis, 2010; Poetz & Schreier, 2012) and so on. There is a rich body of research showing cognitive processes engaged in creativity (Cassotti et al., 2016; Lee & Therriault, 2013; Sawyer, 2012). It is assumed that conflict monitoring (Ruzzoli et al., 2020), inhibitory control (Benedek et al., 2012; Radel et al., 2015), and working memory (Beaty et al., 2014) would be related to creative activities. In other words, one's ability to manage thinking processes can be manifested through one's behaviors upon working on a certain task.

Considering the underlying cognitive mechanisms embedded in cognitive control, the cognitive processes engaged in creativity share many common features with cognitive processes engaged in self-regulation. According to Zimmerman (2001), "Self-regulation refers to the self-directive process through which learners transform their mental abilities into task-related skills." Self-regulation is the process of continuously monitoring progress toward a goal, checking outcomes, and redirecting unsuccessful efforts (Berk, 2003). In other words, self-regulated learning is monitoring and controlling how a student interacts with his/her everyday life.

2. Extrinsic motivation

If there are certain thinking styles or behaviors linked to creative products, it would be possible to promote an individual's capacity for creativity through training in specific thinking styles or behaviors. Torrance (1988) argued that although creativity itself must be self-

discovered, the elements of a creative solution could be taught. Authors et al. (2000) in their experimental study, under the assumption that creativity is a cognitive process of verifying usefulness by applying existing knowledge to new information, found that learners who received a think-aloud training created better-developed and elaborated game rules than those in the control group. They concluded that creativity-enhancing instruction might help learners better organize and apply new information to problem-solving situations. Scott and her colleague (2004) reviewed the effectiveness of creativity for 70 previous studies about developing the capacity of creativity through training programs. They found that well-designed creativity training programs can contribute to the development of cognitive skills. These findings provide evidence that creativity can be trained and improved through intentional effort and practice. It is possible that extrinsic motivational factors can function as rewards or punishments to guide students in a certain way to promote creativity. Especially, students at the elementary level are vulnerable to various types of external stimuli. Theodotou (2014) showed that elementary students could get learning benefits for external rewards. On the other hand, the extent to which intrinsic and extrinsic motivation influence learning varies depending on age (Corpus et al., 2009; Gillet et al., 2012; Lepper et al., 2005). For example, Lepper and his colleagues (2005) investigated age differences in intrinsic and extrinsic motivation and the relationships with learning outcomes by separating the intrinsic from the extrinsic items for 797 3rd through 8th grade students. They found that there was a negative linear trend of intrinsic motivation over time. This implies that motivation is not a concept separable in a dichotomous way such as intrinsic and extrinsic motivation. In the same vein, Deci and Ryan (1985, 2000) categorized the state of motivation into various types depending on the level of self-determination and argued that there existed both extrinsic and intrinsic factors ranging from impersonal to internal. The

continuous spectrum in motivation can be interpreted in a way that an individual with weak intrinsic motivation is relatively more extrinsically motivated. The current study considers students' extrinsic motivation to understand creativity.

3. Gender differences

Studies investigating gender differences in creativity have yielded inconsistent results. Some studies have found that females demonstrate higher levels of creativity (Bart et al., 2015; He, 2018; Kim & Michael, 1995; McCrae et al., 2002), while others showed the opposite (Hora et al., 2022; Stoltzfus et al., 2011). For example, throughout various age levels, females showed a higher level of creative ability. Bart et al. (2015) investigated the gender differences in creative thinking skills with the Torrance Creative Thinking Test (TTCT) Figural Form A for students in 8^{th} and 11^{th} grade. They found that there were statistically significant differences in the majority of the subtests in favor of the females among both the 8^{th} and 11^{th} grade students. Through a four-year longitudinal study, He (2018) observed a total of 775 participants from three age groups (i.e., children, adolescents, and emerging adults) and compared the creative thinking ability of male and female students. It was found that female students showed higher levels of creativity than male students, particularly during adolescence starting at 16 years of age.

On the other hand, Stoltzfus et al. (2011) assessed college students' creativity with a modified version of the Torrance Test of Creative Thinking and found that male students showed higher performance than female students. What is interesting is that the male students with strong feminine gender role characteristics showed the highest level of creativity, followed by both male and female students with strong masculine gender characteristics.

Finally, studies are showing no differences between males and females (Betancourt et al., 2022; Baer & Kaufman, 2008; He & Wong, 2011; Kaufman, 2006; Kaufman et al., 2004; Taylor & Barbot, 2021; Zheng & Xiao, 1983). Focusing on adolescents, Zheng et al. (1983) compared male and female students' creative thinking rated by teachers. Although male students showed higher flexibility scores than female students, there was no difference in creative thinking scores between male and female students. Kaufman (2006) assessed the creative self-perceptions of 3553 students and community members in 56 domains distributed across five factors. It was found that males scored higher on two of the five factors and 28 of the 56 domains, while females scored higher on two factors and 15 domains.

The discrepancies found in the previous studies are assumed to be related to a specific task being used to assess creativity. Considering the differences in the neural mechanisms' dominant function, studies in neuroscience show some evidence that the gender gap would rely on a creativity task, its involved cognitive and neural mechanisms, and the context in which the measure is administered (Abraham et al., 2014; Takeuchi et al., 2016). For example, Abraham et al. (2014), in their behavior and neuroscience study using fMRI found that brain areas related to semantic cognition, rule learning, and decision-making were preferentially engaged in male participants during conceptual expansion, whereas female participants showed higher activity in regions related to speech processing and social perceptions. The study concluded that the male students were relatively more task-oriented, while female students were more conscious of social aspects. A recent meta-analysis study (Hora et al., 2022) showed that a gender gap was related to social and cultural factors. The gender gap declined in a communal compared to an agentic culture. These findings imply that the students' creativity and its manifestation are influenced by school culture as a social factor.

Sociocultural aspects of creativity

Creativity as a cognitive ability is measured through a creativity test but can also be a result or expression of an individual's personality trait which is influenced by social and cultural context (Glăveanu et al., 2019; Kandler et al., 2016). Research from a sociocultural perspective has focused on an environment encompassing creative people and their creative products since different cultural and contextual factors in a different generation influence individuals in different ways and various social and ecological aspects are interwound each other (Choe & Pyo, 2014; Lim & Plucker, 2001; Sawyer, 2012).

The impact of sociocultural context on creativity was supported by many previous studies showing that creativity-related personality traits include socioculturally different factors (Kandler et al., 2016; Kaufman et al., 2009; Kharkhurin & Yagolkovskiy, 2021). For example, Kandler et al. (2016), through multivariate behavioral genetic analysis, found that creativity was better explained by environmental factors rather than genetic factors. van der Zanden et al. (2020) reviewed studies about creativity in adolescence, focusing on supportive and inhibiting factors in adolescents' creativity. They found that supportive social contextual factors included providing interactive relationships such as exchanging ideas and encouraging adolescents to view issues from multiple global and temporal perspectives. The findings from the studies imply that students' creative behavior and attitude are closely related to home and school environments such as parenting style and relationship with parents, peers, and teachers. The unique culture (i.e., home culture or school culture) has an impact on students' attitudes and world view. Here, the home culture covers parenting style, where a parent interacts with students, and what aspects the parent emphasizes on them in everyday life.

1. Parenting Style

Because of the influence of parents' interaction with children on their cognitive, behavioral, and emotional development (Baumrind, 1966; Kuppens & Ceulemans, 2019; Maccoby & Martin, 1983), students' creativity is to be considered with the concept of parenting style and its relation to students' creative attitude. Since Baumrind initially categorized three types of parenting styles, Maccoby and Martin (1983) expanded it using a two-dimensional framework that included authoritative, authoritarian, permissive, and uninvolved. The core idea is that children perceive the world and cope with problems differently depending on the degree of parents' responsiveness and demand. For example, the authoritarian style is based mainly on controlling a child, which is negatively related to creativity. Both authoritative and permissive styles are, on the other hand, based mainly on care and interest in their children, which was found to support creativity (Fearon et al., 2013; Miller et al., 2012; Popescu et al, 2015). While parental involvement with high acceptance of performance outcomes improves children's creativity (Fan & Zhang, 2014), putting too much restraint on children, such as expecting higher grades or performance diminishes children's creativity (Jankowska & Karwowski, 2019). The key variable to the relationship between parenting style and children is the children's perception, whether and how the parenting style is perceived by children compared to what parents intended or implemented. For example, a father thinks he sets a clear rule to support his child's behavioral needs, which is one of the features of the authoritative parenting style, while this rule can be interpreted or perceived as too much pressure or burden by the kid. Then it would be defined as an authoritarian style, although it was intended to be authoritative. Therefore, it is not that a parent's intent is always aligned with how a child feels and perceives. This is a similar situation

to calibrating student learning in teacher education. After learning new knowledge of classroom management, the teacher creates a lesson plan with the new classroom management skill based on the new theoretical framework. To better understand how a classroom management skill helps student learning, it needs to check not only whether the management plan is implemented as planned but also how the students take up what the teacher implements as planned. In this sense, it is more important how the students received the various classroom activities that the teacher implemented.

2. Classroom Culture

Teacher variables, such as a teacher's individualized teaching method, academic pressure, and relationship with students, represent a school culture since teachers, standing at the forefront of students, deliver school philosophy, policy, and practices (McChesney & Cross, 2023). It was argued that teachers who were effective at developing creativity shared common characteristics, including providing an atmosphere of acceptance, asking thought-provoking questions, and valuing originality (Clark, 1983). When students have a positive perception of their relationship with a teacher, the quality of academic functioning improves (Crosnoe et al., 2004). A teacher's pedagogical knowledge is another key aspect influencing students' creativity because it determines how the teacher interacts with students and what aspects the teacher puts more emphasis on, which again influences students' ways of thinking style, approaching a problem, and curiosity, and these collectively create a unique classroom culture (Worku & Alemu, 2021). Also, teachers' emotional support is associated with students' active engagement in school (Ruzek et al., 2016). These studies imply that students who perceive their relationship with the teacher as being positive and more interactive are more likely to engage in their learning

activities (Lee & Kemple, 2014; Olsson & Granberg, 2022; Torrance & Goff., 1989). For example, Torrance et al. (1989) showed that the way teachers respond to students, such as by creating a more responsive environment, was essential to the establishment of a creative teacher-student relationship. The common findings indicated that through positive verbal interactions with students, teachers of young students were able to motivate students to demonstrate creative behaviors (Feitelson & Ross, 1973; Pellegrini, 1984-85). In other words, student-teacher interaction patterns influence the level of students' creative product (Kupers & van Dijk, 2020).

Here, accepting the integrative perspective of creativity (Amabile, 1983; Corazza & Glăveanu, 2020), this study tries to find characteristics influencing students' individual and their surrounding environmental aspects on students' creative attitude. Although quite a few attempts have been made to explore complex dynamics embedded in creativity (Kharkhurin, 2014; Mumford & Hunter, 2005; Shell et al., 2013; Wu et al., 2014), few investigated what factors surrounding students in Korea are interrelated with students' creativity and how various factors influence the emergence of creativity, especially focusing on the student's perception because students are not passive recipient but active agents who interact with what is given from the environment (Bandura, 1997).

3. Interrelation of teacher engagement and parenting style

As was discussed in the earlier sections, there is a rich body of research investigating the impact of parents or teachers on student creativity as a separate variable. Considering that child development, as a complex system of relationships, is affected by multiple levels of the surrounding environment (Bronfenbrenner, 1974; 1986), student development in creativity can be considered in the interrelation between parenting styles and teacher interactional styles.

Parents as primary caregivers interact with their children's teachers who are part of a school system. Parents meet their teachers through parent-teacher conferences or face-to-face talks and learn about their child's academic progress, peer relations, emotional development, and so forth. The teachers also share their concerns and the academic progress of the students with the parents. The interaction between parents and teachers creates its own nurturing context for the children. In this sense, students' creativity is to be investigated not only from a microsystem but also from a mesosystem, a relationship between family and school. Although there is little evidence of the interrelational influence of parents and teachers on students' creativity, researchers showed the possible impact of parent-teacher relationships on students' academic success (Epstein, 1995; Kiuru et al., 2012; Landeros, 2011). A parent-teacher partnership is considered one of the most supportive factors for a child's educational success (Landeros, 2011).

Present study

From students' perspective, self-regulation includes allocating appropriate mental resources to an appropriate stage in problem-solving or thinking processes (Shell et al., 2013). Therefore, measuring students' self-regulated ability can be a good predictor for creative behaviors and products. As a cognitive factor, regulating one's thinking and behaviors is mediated by an individual's motivation (Ahmed, 2017; Schunk & Zimmerman, 2008). If certain thinking styles are linked to creative products, it would be possible to promote an individual's capacity for creativity through training in specific thinking styles or behaviors. One's motivation can play together with the cognitive aspect. Since these intra-individual factors are embedded in a sociocultural context, students' creativity is influenced by inter-individual factors such as interactions with parents, peers, and teachers (Paulus & Dzindolet, 2008). If children feel they

are supported by their parents, it can be hypothesized that the children's creativity is positively related to their parents' cognitive and affective support. Since creativity transcends an individual's cognitive aspect and interacts with social aspects, understanding how creativity is influenced by society and culture can help create better learning environments for students to prepare for an uncertain future. This study tries to explore the inter-relational influence of intra- and inter-personal factors on students' creativity. By incorporating the factors projected through students' perspectives, this research will add knowledge of how individual and sociocultural factors work together and relate to students' creativity.

Methods

This study is based on existing datasets, the Korean Educational Longitudinal Study 2013 (KELS 2013) collected from the 5th grade Korean elementary school students nationwide. The sample was collected via a two-stage stratified cluster random sampling method based on the region and size of the student population in an area. Among the datasets, the first-year dataset was utilized for in-depth investigation. Since the KELS 2013 is the most representative educational dataset in Korea of elementary school children administered by the Korea Educational Development Institute, it was assumed to help thoroughly understand the characteristics of the students as baseline data (the 1st wave) associated with creativity.

1) Participants

The sample consisted of 7,324 5th grade elementary students (around 11 years old) from 242 schools in Korea. Among them were 3,623 male students (49.5%) and 3,701 female students (50.5%). Among the participants, 3,109 students (42.4%) attended schools in metropolitan cities

and 4,215 students were from schools located in small and medium-sized cities. KELS 2013 administered by the Korean Educational Development Institute (KEDI) aimed to comprehensively investigate the effects of school and home education, environmental characteristics associated with Korean children, and youth's cognitive and affective growth.

2) Survey Items and Variables

The survey responses were from a student survey; therefore, all the responses are based on self-report (See Table 1 for the question items). The items in the KELS 2013 survey were selected to validate our theory that micro-environmental characteristics especially at home and school affect the creativity of elementary students who had certain intra-individual characteristics as reflected in academic achievement, self-regulation skills, and extrinsic motivation and inter-individual characteristics, including parenting style, social relationship with parents, peers, and teachers, and perceived characteristics of teachers (teacher's academic pressure, and teaching methods). Variables were constructed using the mean of the items that constitute a respective construct. In the case of achievement scores, the mean of Korean, math, and English scores was used. The outcome variable, creativity, was composed of 5 items, and the other covariates were as follows: 5 self-regulation items, 6 peer relations items, 4 parental relationship items, 2 authoritarian parenting style items, 2 autonomy support items, 8 teachers' student-centered teaching methods items, 4 teacher's academic pressure items, and 5 teacher relationship with students items. These items were on a five-point Likert scale except for extrinsic motivation items which were obtained on a four-point Likert scale (1 strongly disagree - 4 strongly agree).

3) Methods of Analysis

The factor structures were analyzed with exploratory factor analysis with the relevant groups of items. To be sure that relevant items constituted a single construct (unidimension), Rasch measurement model with the relevant items that constituted each respective construct (dimension) was utilized. Since the 5-point Likert scale is not on an interval scale, it violates the assumption of running factor analysis (Wright, 1997). These non-interval raw data must be constructed into sample-distribution free and item-distribution free measures before they can be analyzed using statistics requiring linear, interval data (Wright, 1997). The Rasch model overcomes this problem by transforming non-interval raw data into logit scale measures, which have constant interval meaning and provide objective and linear measurement from ordered category responses (Linacre, 2006). Rasch model can assess item parameters (e.g., item difficulty) and person ability parameters objectively because item parameters do not vary depending on responders and person parameters also do not vary depending on item characteristics; and the probability of responding to one item does not affect the probability of responding to the other items (local independence). It can also assess dimensionality using PCA on the Rasch residuals (see the Rasch analysis results in Table 2).

According to Linacre's (2019), if the disattenuated correlation of the Rasch residuals is greater than 0.7, the evidence of unidimensionality is clear; if it is lower than 0.3, it indicates multidimensionality. Another criterion is if the 1st contrast of Rasch residuals is less than 2, it is assumed to be unidimension. If the 1st contrast of Rasch residuals is greater than 2, there is the possibility of mulitidimensionality[1]. In this case, the non-randomness of the residuals should be checked. If they are randomly distributed, it is considered unidimensional. A construct was

[1] The randomness of residuals refers to the absence of any systematic patterns or trends in the residuals after fitting the Rasch model.

considered unidimensional when the principal component analysis of the Rasch residuals showed the correlation between item clusters (contrasts) was high ($r > 0.7$). In addition, when the first contrast of the residual eigenvalue was greater than 2, the randomness of the residuals was checked, along with disattenuated correlations. Additionally, the point-biserial correlation was administered between the target item and the related measure, infit (an inlier-sensitive fit statistic) which was more sensitive to unexpected patterns of observations by persons on items that were roughly targeted on them, and outfit (an outlier-sensitive fit statistic) of the item, step order of items, and differentially functioning items (DIF items). If an item fit statistic ranged from 0.5 to 1.5, the item was regarded as good for the construct. If it was greater than 1.5, it was considered underfit, and when lower than 0.5 it was considered overfit. It was checked if the item category worked as intended, the higher order represented the higher ability of responders to endorse the items.

After deleting problematic items that may not constitute the respective construct, the mean of the items that constituted a single dimension were utilized as respective variables. Additionally, it was obtained that the coefficient alpha on the items constituted each factor. Then a two-level hierarchical linear model was constructed to investigate the effect of both individual psychological characteristics and social and environmental factors, such as parenting attitude/style (authoritarian parenting style, autonomy-supportive parenting, and creating an environment for study, and relationship with their children) and teacher factors (student-centered teaching methods, relationship with their students, teacher's academic pressure) without violating an independence assumption.

4) Model

Figure 1 illustrates a two-level hierarchical model. Based on our literature review, we included for level 1, gender, self-regulation, academic achievement, extrinsic motivation, peer relations (attachment), and three groups of parenting style-related items. Information on students' perceptions of their teacher's student-centered teaching methods, their teacher's relationship with them, and their teachers' academic pressure (teachers' stimulus for or concern about their students) was aggregated for level 2. In this way, interaction effects between level 1 and level 2 were also investigated, i.e., teaching methods and parents' autonomy-supportive parenting (mesosystem).

Insert Figure 1 Here

Results

Initial investigation showed that the groups of items related to each construct were respective factors except that items that constitute a relationship with parents and autonomy-supportive parenting. They were clustered more or less. When the factor number was constrained as 10, 10 groups of items were loaded on respective factors. The two groups of items (relationship with parents and autonomy-supportive parenting) turned out to be loaded on each separate factor.

Insert Table 1 Here

The Rasch measurement model was run to ensure that all the factors are unidimensional (a single construct). When the items related to the relationship between parents and autonomy-supportive parenting are put together, Rasch modeling result shows the indication of multidimensionality. Disattenuated correlation was low ($r = 0.34$) and the eigenvalue of the first contrast was over 0.2. However, separate analyses with the two groups of items were run and both showed unidimensionality (See Table 2). In all measures, the explained variance by the Rasch model was over 50% and none has a low disattenuated correlation ($r > .60$). The eigenvalue of the 1st contrast was less than 2 except for teaching methods, and the disattenuated correlation of teaching methods was 0.82 (evidence of unidimensionality). However, two items hindered fit statistics in the case of extrinsic motivation. After deleting two items, the Rasch model outcome showed a solid unidimensionality. In addition, the internal consistency reliability (or coefficient α) of all 10 groups of items on the separate factor was over 0.7 and the reliability of creativity was 0.878 (See also Table 1).

Based on these results, the mean of the items constituting the respective construct was used as a unique variable. Thus, creativity can be investigated using respective independent constructs (variables).

Insert Table 2 Here

The following are the descriptive statistics of the constructed variables for running a two-level model using HLM software. The mean of creativity was 3.5 (*SD* = 0.77), parental autonomy support was 3.93 (*SD* =.89), and relationship with their teacher was 3.91 (*SD* = 0.32).

In order to find out the amount of variance at level 2, the unconditional model was run without any predictors. It shows that 93% of the variance was at level 1, and the amount of variance at level 2 was 0.07 {= .042/(.042+.559)}, which means seven percent of variances are at school (level 2). This justified the use of multilevel modeling (See Table 3).

Insert Table 3 Here

The individual characters were incorporated, such as gender, self-regulation, and parental relationship, into the level 1 model by incorporating random effects of level 1 slopes. Table 4 shows the results. All variables except for extrinsic motivation were statistically significant. The intercept and the random effects of such four variables as self-regulation, academic achievement, peer relations, and autonomy-supporting parenting were statistically significant. This means that there is an individual difference in the above variables. Thus, in our final model, four random effects were kept and the other variables were constrained (See Table 5).

Insert Table 4 Here

For the final model, the level 2 variables related to students' perceptions of their teacher's behavior were checked. Teachers' teaching methods, teachers' academic pressure or academic concern for students, and their relationship with students were aggregated into level 2. The correlation was checked among the three variables (See Table 5). The correlation between teachers' student-centered teaching methods (teaching methods) and their relationship with students was high (r = .897). The three variables, teacher relationship with a student, teacher pressure, and teaching method were not put at the same time into level 2 to avoid multicollinearity. Only one of the two variables (i.e., teaching methods or their relationship) along with the teacher's academic pressure were included in a separate model at level 2 (See tables 6 and 7).

Insert Table 5 Here

In the first final model 1 (Figure 2, its results in Table 6), the study included the teacher's teaching methods and the teacher's academic pressure, as level 1 intercept and four slope predictors (self-regulation, academic achievement, peer relations, autonomy supporting parenting). The results of the analysis showed that the most significant variable that affected the students' creativity was self-regulation habit/attitude (b = .286, β = .279) which was followed by peer relations (b = .185, β = .202), academic achievement (b = 0.005, β = .201), gender (b = .231, β = .150), and relationship with parents (b = .117, β = .128).

The effect of all level 1 variables was statistically significant except for extrinsic motivation. In the case of level 2, only the teachers' student-centered teaching method (b = .089, β = .038) was statistically significant. All the statistically significant variables are positively associated with students' creativity. However, the effect size of the teaching methods was mediocre. There were also statistically significant random effects associated with the intercept and slope of peer relations, and autonomy-supportive parenting styles, which means that there exist individual differences in the mean and the two slopes (peer-relations, autonomy-supporting parenting) about creativity. The existence of a random slope also means the possibility of incorporating more predictors for peer relations and autonomy-supporting parenting.

Insert Figure 2 Here

Insert Table 6 Here

The final model 2 incorporating teachers' relationship with their students, instead of using teachers' student-centered teaching methods, showed similar results. There was no statistically significant interaction effect between level 1 and level 2. The most significant variable that affected the students' creativity was self-regulation habit/attitude (b = .285, β = .278) which was followed by peer relations (b =.184, β =.201), academic achievement (b

= .005, β = .200), gender (b = .231, β =.150), student's relationship with their teacher (b = .133, β = .057), and relationship with parents (b = 0.117, β = .134). There was no statistically significant interaction effect between student characteristics (including students' perception of their parents' autonomy support) and teacher characteristics. The effects on all level 1 variables were statistically significant except for extrinsic motivation. In the case of level 2, only the teacher's relationship with students (b = .117 β = .134) was statistically significant. There were also statistically significant random effects associated with intercepts and slope (self-regulation, peer-relations, and autonomy-supporting parenting styles), which means that there exist individual differences in the mean and the three slopes (self-regulation, peer-relations, autonomy-supporting parenting) about creativity. The statistically significant random slopes mean the possibility of incorporating more predictors as the three slope predictors.

Insert Table 7 Here

Discussion

The study investigated the relationships between individual and sociocultural factors with Korean students' creativity from the student's perspective. Using large-scale National data, the authors identified that individual and socio-cultural factors influenced students' creativity. The unidimensionality of each construct was checked and the mean of the items that constituted each construct was used as respective variables for a two-level hierarchical linear model, using rigorous methods, Rasch measurement model analysis. The level 1 analysis showed that a

student's creativity was explained by their self-regulation skills, academic achievement, relationship with parents, and their parents' authoritarian and autonomous parenting style.

More specifically, the student's academic self-regulation is the most influential variable in predicting students' creativity in Korea, followed by their academic achievement and relationship with their parents. Self-regulated thinking subsumes cognitive processes of allocating an appropriate amount of mental resources to an appropriate stage or a targeted task both at a micro and macro level. Therefore, the findings from the current survey study correspond to the previous behavioral and neuroscience studies that show the relationship between cognitive process and creativity (Benedek et al., 2014; Cancer et al., 2023; Khalil et al., 2019). For example, in their experimental study, Cancer et al. (2023) showed that executive functions involved in creative problem-solving with divergent thinking. In the sense that executive functions are a key component in cognitive processing such as decision-making and problem-solving, self-regulation is assumed to play an important role in creative thinking behaviors. These findings also extend the influence on student creativity to a school context as a social factor. Peer relations and the relationship with the teacher are related to students' creative behaviors. Although parents play the primary role in making an impact on children and the children's attachment to their parents greatly influences them in many ways, the findings from the analyses imply that students' creativity is better explained together with the aspect of human relationships in school, students' attachment to their peers and teachers. The informal relationship with teachers has a larger impact than that of teacher's academic pressure and even teaching methods (Compare Tables 6 and 7). Although the effect size was small, how teachers treated their students in their everyday lives seemed to play an important role in students' creative thinking. Verschueren (2015) reviewed studies of the relationship between teachers and

students in middle childhood and argued that although teacher-student relationships are not exclusive or persistent like parent-child relationships, children may seek support and comfort from their teacher in times of stress and that the relationship with the teacher may help them to feel more comfortable exploring their learning environment (Verschueren & Koomen, 2012). The students who positively perceived their relationship with teachers are assumed to receive more emotional reinforcement from their teachers. This positive reinforcement may have heightened the level of spontaneous, regulated behaviors from the students, which in turn was manifested in the students' creative behaviors in this study.

There are quite a few studies that investigated the influence of teachers (Hamre & Pianta, 2001; Jerome et al., 2009) or peers (Howes et al., 1994) on individual students' academic performance or characteristics. However, it is rare to investigate the dynamics in a mesosystem, the influence of sociocultural factors interacting with individual factors. A two-level hierarchical linear model showed that there did not exist any significant interaction effect on creativity between intra-individual and home environmental factors and teacher factors. From a developmental perspective, students in 5th grade are in the phase of entering an adolescent period. Starting from this age, students start putting more weight on their relationships with peers (Nickerson & Nagle, 2005; Vieno et al., 2005) and rely less on their relationships with their teachers (Hughes & Cao, 2018; O'Connor, 2010). These findings are also found in this survey study showing the waning influence of teacher-related variables which in turn leads to the lack of interaction effects between the teacher and such level-one variables as self-regulation, achievement, and interaction with peers. Although the relationship between teachers and teaching methods is statistically significant in each model, the effect size of the respective variable was small. Therefore, the participants in this study are at an inflection point in which

there is an increase in peer influence and a decline in teacher influence. Compared to the influence of teachers, the influence of parents on students' creativity was higher.

Among the parents' influences, what is interesting is that parents' authoritarian style positively influenced students' creativity. It is somewhat opposite to the previous studies showing the relationship between authoritative parenting style and child creativity (e.g. Mehrinejad et al., 2015; Miller et al., 2012). This finding can be interpreted from the cultural background that Asian students have.

Compared to Western parents, throughout their entire lives, Asian parents more deeply engage in their children's lives. They often demand stricter behaviors and attitudes from their child with obedience (Cui et al., 2016; Kim & Park, 2020). When the authoritarian style was combined with sacrifice-based Asian nurturing, the authoritarian style would be confounded and perceived in a distorted way (Kim et al., 2011). Therefore, the authoritarian style from an Asian student perspective can be perceived as being more supportive.

The study has limitations in that the influence of individual and social factors on creativity was measured for only one year. Considering a rapid change in both cognitive and social aspects especially during adolescence, making a comparison with another cohort or tracing one cohort longitudinally will provide us with a broader trend in creativity development and its relations with individual and social factors.

Conclusion

This study investigated the correlation of intra-individual and sociocultural factors with students' creativity. The analyses showed that methods to enhance students' creativity are related to enhancing students' self-regulation skills, peer relationships, academic achievement,

relationships with teachers, and a supportive parenting style. The role of self-regulation was the major factor explaining creativity. Considering that cognitive processes underlying creative thinking, controlling one's thinking and behaviors through inhibiting unrelated subgoals and activating associative processes can be a key aspect of students' creativity. An authoritarian parenting style seemed to be a unique characteristic in Asian culture, which did not harm children's creative thinking and behaviors. In addition to parent support, the influence of school culture on student creativity was manifested through peer relations and the emotional bond with their teachers. Given that students' life is largely embedded in a school system, creating a supportive environment for our students would have a positive impact on their creative thinking and behaviors.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

Abraham, A., Thybusch, K., Pieritz, K., & Hermann, C. (2014). Gender differences in creative thinking: behavioral and fMRI findings. *Brain imaging and behavior*, *8*(1), 39–51. https://doi.org/10.1007/s11682-013-9241-4.

Ahmed, W. (2017). Motivation and self-regulated learning: A multivariate multilevel Analysis. *International Journal of Psychology and Educational Studies*, *4*(3), 1–11. https://doi.org/10.17220/ijpes.2017.03.001.

Amabile, T. M. (1983). The social psychology of creativity; A componential conceptualization. *Journal of Personality and Social Psychology 45*, 357-376.

Author et al. (2000).

Baer, J., & Kaufman, J. C. (2008). Gender differences in creativity. *Journal of Creative Behavior*, *42*(2), 75-105. https://doi.org/10.1002/j.2162-6057.2008.tb01289.x.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control.* W.H. Freeman and Company.

Barbot, B., Besançon, M., & Lubart, T. I. (2011). Assessing creativity in the classroom. *The Open Education Journal, 4*, 124-132. doi: 10.2174/1874920801104010058.

Bart, W. M., Hokanson, B., Sahin, I., & Abdelsamea, M. A. (2015). An investigation of the gender differences in creative thinking abilities among 8th and 11th grade students. *Thinking Skills and Creativity, 17*, 17-24.

Baumrind, D. (1966). Effects of authoritative parental control on child behavior. *Child Development, 37*, 887–907.

Beaty, R. E., Silvia, P. J., Nusbaum, E. C., Jauk, E., & Benedek, M. (2014). The role of associative and executive processes in creative cognition. *Memory & Cognition, 42(7),* 1186–1197.

Benedek, M., Könen, T., & Neubauer, A. C. (2012). Associative abilities underlying creativity. *Psychology of Aesthetics, Creativity, and the Arts, 6*(3), 273–281. https://doi.org/10.1037/a0027059.

Benedek, M., Jauk, E., Sommer, M., Arendasy, M., & Neubauer, A. C. (2014). Intelligence, creativity, and cognitive control: the common and differential involvement of executive functions in intelligence and creativity. *Intelligence 46*, 73–83. doi: 10.1016/j.intell.2014.05.007.

Berk, L. E. (2003). *Child Development* (6th ed.). Boston: Allyn and Bacon.

Betancourt, J., Valadez, M. de los D., Rodríguez-Naveiras, E., Flores, J. F., & Borges, Á. (2022). Differences between Creativity and Gender in Students with High Abilities Attending a School with Total Grouping. *Children, 9*(7), 1081. http://dx.doi.org/10.3390/children9071081.

Bronfenbrenner, U. (1974). Developmental research, public policy, and the ecology of childhood. *Child development, 45*, 1-5.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: research perspectives. *Developmental Psychology*, 22, 723–742. doi: 10.1037/0012-1649.22.6.723.

Cancer, A., Iannello, P., Salvi, C., Antonietti, A. (2023). Executive functioning and divergent thinking predict creative problem-solving in young adults and elderlies. *Psychological Research 87*, 388–396. https://doi.org/10.1007/s00426-022-01678-8.

Cassotti, M., Agogué, M., Camarda, A., Houdé, O., and Borst, G. (2016). Inhibitory control as a core process of creative problem solving and idea generation from childhood to adulthood. New Dir. Child Adolesc. Dev., 61–72. doi: 10.1002/cad.20153.

Choe, I, & Pyo, J. (2014). A study for developing creativity test based on implicit theories of Korean people. *Korean Journal of Social and Personality Psychology, 28*(1), 27-47.

Clark, B. (1983). *Growing Up Gifted: Developing the Potential of Children at Home and at School* (2nd ed.). Colunrbus, GH: Charles E. Merrill.

Corazza, G. E., & Glăveanu, V. P. (2020). Potential in creativity: Individual, social, material perspectives, and a dynamic integrative framework. *Creativity Research Journal, 32*(1), 81-91. https://doi.org/10.1080/10400419.2020.1712161.

Corpus, J. M., McClintic-Gilbert, M., & Hayenga, A. O. (2009).Within-year changes in children's intrinsic and extrinsic motivational orientations: Contextual predictors and academic outcomes. *Contemporary Educational Psychology, 34*, 154–166.

Crosnoe, R., Johnson, M. K., & Elder, Jr., G. H. (2004). Intergenerational bonding in school: The behavioral and contextual correlates of student-teacher relationships. *Sociology of Education, 77*, 60-81.

Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 313–335). Cambridge University Press.

Cui, N., Xue, J., Connolly, C. A., & Liu, J. (2016). Does the gender of parent or child matter in child maltreatment in China? *Child Abuse & Neglect, 54*, 1–9.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: human needs and the self-determination of behaviour. *Psychological Inquiry, 11*, 227–268.

Dong, Y., Lin, J., Li, H., Cheng, L, Niu, W., & Tong, Z. (2022). How parenting styles affect children's creativity: Through the lens of self. *Thinking Skills and Creativity, 45*, 101045. https://doi.org/10.1016/j.tsc.2022.101045.

Epstein, J. L. (1995). School–Family–Community partnerships: Caring for the children we share. *Phi Delta Kappa, 76*(9), 701–712.

Fan, J., & Zhang, L. (2014). The role of perceived parenting styles in thinking styles. *Learning and Individual Differences, 32*, 204–211. https://doi.org/10.1016/j.lindif.2014.03.004.

Fearon, D. D., Copeland, D., & Saxon, T. F. (2013). The relationship between parenting styles and creativity in a sample of Jamaican children. *Creativity Research Journal, 25*, 119–128. https://doi.org/10.1080/10400419.2013.752287.

Feitelson, D., & Ross, S. (1973). The neglected factor-play. *Hunan Development, 16*, 202-223.

Gillet, N., Vallerand, R. J. & Lafrenière, M. K. (2012). Intrinsic and extrinsic school motivation as a function of age: the mediating role of autonomy support. *Social Psychology of Education, 15*, 77–95. https://doi.org/10.1007/s11218-011-9170-2.

Glăveanu, V. P. (2010). Principles for a cultural psychology of creativity. *Culture & Psychology, 16*, 147–163. doi: 10.1177/1354067x10361394.

Glăveanu, V. P., Hanson, M. H., Baer, J., Barbot, B., Clapp, E. P., Corazza, G. E., Hennessey, B., Kaufman, J., Lebuda, I., Lubart, T., Montuori, A., Ness, I., Plucker, J., Reiter-Palmon, R., Sierra, Z., Simonton, D. K., Neves-Pereira, M. S., & Sternberg, R. J. (2019). Advancing Creativity Theory and Research: A Socio-cultural Manifesto. *The Journal of Creative Behavior*. *54*. https://doi.org/10.1002/jocb.395.

Guilford, J. P. (1950). Creativity. *American Psychologist, 5(9)*, 444–454. https://doi.org/10.1037/h0063487.

Guilford, J. P. (1967). Creativity: Yesterday, today, and tomorrow. *The Journal of Creative Behavior, 1*(1), 3–14. https://doi.org/10.1002/j.2162-6057.1967.tb00002.x.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher–child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72*, 625– 638.

He, W. (2018). A 4-year longitudinal study of the sex-creativity relationship in childhood, adolescence, and emerging adulthood: findings of mean and variability analyses. *Frontiers in Psychology, 9*:2331. doi: 10.3389/fpsyg.2018.02331.

He, W-j., & Wong, W-c. (2011). Gender differences in creative thinking revisited: Findings from analysis of variability. *Personality and Individual Differences. 51*(7), 807-811.

Hora, S., Badura, K. L., Lemoine, G. J., & Grijalva, E. (2022). A meta-analytic examination of the gender difference in creative performance. *Journal of Applied Psychology, 107*(11), 1926–1950. https://doi.org/10.1037/apl0000999.

Howes, C., Hamilton, C. E., & Matheson, C. C. (1994). Children's relationships with peers: Differential associations with aspects of the teacher–child relationship. *Child Development*, **65**, 253– 263.

Hughes, J. N., & Cao, Q. (2018). Trajectories of teacher-student warmth and conflict at the transition to middle school: effects on academic engagement and achievement. *Journal of School Psychology, 67*, 148–162. https://doi.org/10.1016/j.jsp.2017.10.003.

Jankowska, D., & Gralewski, J. (2019). Family factors and development of creative thinking. *Personality and Individual Differences, 142*, 202-206. https://doi.org/10.1016/j.paid.2018.07.030.

Jankowska, D., & Gralewski, J. (2022). The familial context of children's creativity: Parenting styles and the climate for creativity in parent-child relationship. *Creativity Studies, 15*(1), 1-24. https://doi.org/10.3846/cs.2022.13449.

Jerome, E. M., Hamre, B. K., & Pianta, R. C. (2009). Teacher–child relationships from kindergarten to sixth grade: early childhood predictors of teacher-perceived conflict and closeness. *Social Development.* 18, 915–945. doi: 10.1111/j.1467-9507.2008.00508.x.

Kandler, C., Riemann, R., Spinath, F. M., Borkenau, P., & Penke, L. (2016). The nature of creativity: The roles of genetic factors, Personality traits, cognitive abilities, and environmental sources. *Journal of Personality and Social Psychology, 111*, 230-249.

Kaufman, J. C. (2006). Self-reported differences in creativity by ethnicity and gender. *Applied Cognitive Psychology, 20*, 1065–1082. doi: 10.1002/acp.1255.

Kaufman, J. C., Baer, J., & Gentile, C. A. (2004). Differences in gender and ethnicity as measured by ratings of three writing tasks. *Journal of Creative Behavior, 38*(1), 56-69.

Kaufman, J. C., Cole, J. C., & Baer, J. (2009). The construct of creativity: Structural model for self-reported creativity ratings. *Journal of Creative Behavior, 43*, 119-132.

Kenett, Y. N., Levy, O., Kenett, D. Y., Stanley, H. E., Faust, M., and Havlin, S. (2018). Flexibility of thought in high creative individuals represented by percolation analysis. Proc. Natl. Acad. Sci. U.S.A. 115, 867–872. doi: 10.1073/pnas.1717362115.

Khalil, R., Godde, B., & Karim, A. A. (2019). The Link between creativity, cognition, and creative drives and underlying neural mechanisms. *Frontiers in Neural Circuits, 13*:18. https://doi.org/10.3389/fncir.2019.00018.

Kharkhurin, A. V. (2014). Creativity.4in1: Four-criterion construct of creativity. *Creativity Research Journal, 26*(3), 338-352. https://doi.org/10.1080/10400419.2014.929424.

Kharkhurin, A. V., & Yagolkovskiy, S. R. (2021) Cultural Variations in Evaluation of Creative Work: A Comparison of Russian and Emirati Samples. *Frontiers in Psychology, 12*:764213. https://doi.org/10.3389/fpsyg.2021.764213.

Kim, K. H., Lee, H., Chae, K., Andersen, L., & Lawrence, C. (2011). Creativity and Confucianism among American and Korean educators. *Creativity Research Journal, 23*, 357–371.

Kim, J., & Michael, W. B. (1995). The relationship of creativity measures to school achievement and to preferred learning and thinking style in a sample of Korean high school students. *Educational and Psychological Measurement, 55*(1), 60–74. https://doi.org/10.1177/0013164495055001006.

Kim, K. H., & Park, S-G. (2020). Relationship between Parents' Cultural Values and Children's Creativity. *Creativity Research Journal, 32*(3), 259-273, doi: 10.1080/10400419.2020.1821566.

Kiuru, N., Aunola, K., Torppa, M., Lerkkanen, M. K., Poikkeus, A. M., Niemi, P., Viljaranta, J., Lyyra, A. L., Leskinen, E., Tolvanen, A., & Nurmi, J. E. (2012). The role of parenting styles and teacher interactional styles in children's reading and spelling development. *Journal of school psychology, 50*(6), 799–823. https://doi.org/10.1016/j.jsp.2012.07.001.

Kuppens, S., & Ceulemans, E. (2019). Parenting styles: A closer look at a well-known concept. *Journal of Child and Family Studies, 28,* 168-181.

Landeros, M. (2011). Defining the 'good mother' and the 'professional teacher': parent-teacher relationships in an affluent school district. *Gender and Education, 23*(3), 247–262. https://doi.org/10.1080/09540253.2010.491789.

Lee, I. R., & Kemple, K. (2014). Preservice teachers' personality traits and engagement in creative activities as predictors of their support for children's creativity. *Creative Research Journal, 26,* 82-94.

Lee, C. S., & Therriault, D. J. (2013). The cognitive underpinnings of creative thought: A latent variable analysis exploring the roles of intelligence and working memory in three creative thinking processes. *Intelligence, 41(5),* 306–320. https://doi.org/10.1016/j.intell.2013.04.008.

Lepper, M. R., Corpus, J. H., & Iyengar, S. S. (2005). Intrinsic and extrinsic motivational orientations in the classroom: Age differences and academic correlates. *Journal of Educational Psychology, 97*(2), 184–196. https://doi.org/10.1037/0022-0663.97.2.184.

Lim, W., & Plucker, J. A. (2001). Creativity through a lens of social responsibility: Implicit theories of creativity with Korean samples. *The Journal of Creative Behavior, 35*, 115-130. https://doi.org/10.1002/j.2162-6057.2001.tb01225.x.

Linacre, J. M. (2006). A user's guide to WINSTEPS/MINISTEP: Rasch-model computer programs. Chicago, IL: Winsteps.com

Linacre, J. M. (2019). Detecting multidimensionality in Rasch data using Winsteps Table 23. Retrieved from https://www.rasch.org/rmt/rmt162f.htm.

Lubart, T. I., & Sternberg, R. J. (1998). Creativity across time and place: life span and cross-cultural perspective. *High Ability Study, 9*, 59–74. doi: 10.1080/1359813980090105.

Maccoby, E. E., & Martin, J. A. (1983). Socialization in the context of the family: Parent-child interaction. In P. H. Mussen (Series Ed.) & E. M. Hetherington (Vol. Ed.), Handbook of Child Psychology: Vol. IV. Socialization, Personality and Social Development (4th ed., pp. 1-101). New York: Wiley.

McChesney, K., & Cross, J. (2023). How school culture affects teachers' classroom implementation of learning from professional development. *Learning Environments Research*. https://doi.org/10.1007/s10984-023-09454-0.

McCrae, R. R., Costa, P. T., Jr., Terracciano, A., Parker, W. D., Mills, C. J., De Fruyt, F., & Mervielde, I. (2002). Personality trait development from age 12 to age 18: Longitudinal, cross-sectional and cross-cultural analyses. Journal of Personality and Social Psychology, 83(6), 1456–1468. https://doi.org/10.1037/0022-3514.83.6.1456.

Mednick, S. (1962). The associative basis of the creative process. *Psychological Review. 69*, 220–232. doi: 10.1037/h0048850.

Mehrinejad, S., A., Rajabimoghadam, S., & Tarsafi, M. (2015). The relationship between parenting styles and creativity and the predictability of creativity by parenting styles. *Procedia - Social and Behavioral Sciences, 205*, 56 – 60.

Mainemelis, C. (2010). Stealing fire: Creative deviance in the evolution of new ideas. *Academy of Management Review*, *35*(4), 558–578.

Miller, A., Lambert, A. D., & Speirs Neumeister, K. L. (2012). Parenting style, perfectionism, and creativity in high-ability and high-achieving young adults. *Journal for the Education of the Gifted, 35*, 344-365.

Moruzzi, C. (2021). Measuring creativity: an account of natural and artificial creativity. *European Journal for Philosophy of Science, 11*, 1. https://doi.org/10.1007/s13194-020-00313-w.

Mumford, M. & Hunter, S. (2005). Innovation in organizations: A multi-level perspective on creativity. *Research in Multi-Level Issues. 4*, 9-73. DOI:10.1016/S1475-9144(05)04001-4.

Nickerson, A. B., & Nagle, R. J. (2005). Parent and peer attachment in late childhood and early adolescence. *Journal of Early Adolescence, 25,* 223-249.

O'Connor, E. (2010). Teacher–child relationships as dynamic systems. *Journal of School Psychology, 48,* 187–218. https://doi.org/10.1016/j.jsp.2010.01.001.

Olsson, J., & Granberg, C. (2022) Teacher-student interaction supporting students' creative mathematical reasoning during problem solving using Scratch. *Mathematical Thinking and Learning*, DOI: 10.1080/10986065.2022.2105567.

Paulus, P. B., & Dzindolet, M. (2008). Social influence, creativity and innovation. *Social Influence, 3*(4), 228-247. https://doi.org/10.1080/15534510802341082.

Pellegrini, A. D. (1984-1985). The effects of exploration and play on young children's associative fluency. *Imagination, Cognition and Personality, 4*, 29–40. https://doi.org/10.2190/0W5N-X8E8-WKWF-9A1R.

Poetz, M. K., & Schreier, M. (2012). The value of crowdsourcing: Can users really compete with professionals in generating new product ideas? *Journal of Product Innovation Management, 29*(2), 245–256.

Popescu, M.I., Moraru, A., & Sava, N.I. (2015). Familial barriers in the development of creativity in preschoolers. *Procedia – Social and Behavioral Sciences, 187*, 601–606. https://doi.org/10.1016/j.sbspro.2015.03.112

Radel, R., Davranche, K., Fournier, M., & Dietrich, A. (2015). The role of (dis) inhibition in creativity: Decreased inhibition improves idea generation. *Cognition, 134*, 110–120.

Renzulli, J. S. (2016). The three-ring conception of giftedness: A developmental model for promoting creative productivity. In S. M. Reis (Ed.). *Reflections On Gifted Education* (pp. 173-192). Waco, TX: Prufrock Press.

Runco, M. A. (1988). Creativity research: Originality, utility, and integration. *Creativity Research Journal, 1*(1) 1, 1-7. http://dx.doi.org/10.1080/10400418809534283.

Ruzek, E. A., Hafen, C. A., Allen, J. P., Gregory, A., Mikami, A. Y., & Pianta, R. C. (2016). How teacher emotional support motivates students: The mediating roles of perceived peer relatedness, autonomy support, and competence. *Learning and Instruction, 42*, 95-103. https://doi.org/10.1016/j.learninstruc.2016.01.004.

Ruzzoli, M., McGuinness, A., Morís Fernández, L., & Soto-Faraco, S. (2020). From cognitive control to visual incongruity: Conflict detection in surrealistic images. *PloS one, 15*(6), e0224053. https://doi.org/10.1371/journal.pone.0224053.

Sawyer, R. K. (2012). *Explaining creativity: The science of human innovation* (2nd ed.). Oxford University Press.

Scott, G., Leritz, L. E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal, 16*(4), 361-388. https://doi.org/10.1080/10400410409534549.

Shell, D. F., Hazley, M. P., Soh, L., Ingraham, E., & Ramsay, S. (2013). Associations of students' creativity, motivation, and self-regulation with learning and achievement in college computer science courses. 2013 IEEE Frontiers in Education Conference (FIE), 2013, pp. 1637-1643, doi: 10.1109/FIE.2013.6685116.

So, K., Hu, Y-j., & Park, J. (2017). Making our schools more creative: Korea's efforts and challenges. *International Education Journal: Comparative Perspectives, 16*(4), 77-88.

Sternberg, R. J., Lubart, T. I., Kaufman, J. C., & Pretz, J. E. (2005). Creativity. In K. J. Holyoak & R. G. Morrison (Eds.), *The Cambridge handbook of thinking and reasoning* (pp. 351–369). Cambridge University Press.

Stoltzfus, G., Nibbelink, B., Vredenburg, D., & Thyrum, E. (2011). Gender, gender role, and creativity. *Social Behavior and Personality: An international journal, 39*(3), 425-432.

Schunk, D. H., & Zimmerman, B. J. (2008). *Motivation and self-regulated learning: Theory, research, and applications.* Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Takeuchi, H., & Kawashima, R. (2016). Neural Mechanisms and Children's Intellectual Development: Multiple Impacts of Environmental Factors. *The Neuroscientist : a review journal bringing neurobiology, neurology and psychiatry*, *22*(6), 618–631. https://doi.org/10.1177/1073858415610294.

Taylor, C. L., & Barbot, B. (2021). Gender differences in creativity: Examining the greater male variability hypothesis in different domains and tasks. *Personality and Individual Differences, 174*, 110661. https://doi.org/10.1016/j.paid.2021.110661.

Theodotou, E. (2014). Early years education: are young students intrinsically or extrinsically motivated towards school activities? A discussion about the effects of rewards on young children's learning. *Research in Teacher Education*, *4*(1), 17-21.

Torrance, E. P. (1988). The nature of creativity as manifest in its testing. In R. Sternberg (Ed.), *The nature of creativity: Contemporary psychological perspectives*. Cambridge: Cambridge University Press.

Torrance, E. P., & Goff, K. (1989). A quiet revolution. *Journal of Creative Behavior, 23,* 136-145.

van der Zanden, P. J. A. C., Meijer, P. C., & Beghetto, R. A. (2020). A review study about creativity in adolescence: Where is the social context? *Thinking Skills and Creativity, 38,* https://doi.org/10.1016/j.tsc.2020.100702.

Verschueren, K. (2015). Middle childhood teacher–child relationships: Insights from an attachment perspective and remaining challenges. In G. Bosmans & K. A. Kerns (Eds.), *Attachment in middle childhood: Theoretical advances and new directions in an emerging field.* New Directions for Child and Adolescent Development, 148, 77–91.

Verschueren, K.,& Koomen, H. (2012). Teacher–child relationships from an attachment perspective. *Attachment & Human Development*, *14*, 205–211.

Vieno, A., Perkins, D. D., Smith, T. M., & Santinello, M. (2005). Democratic school climate and sense of community in school: A multilevel analysis. *American Journal of Community Psychology, 36*, 327-341.

Woodman, R. (1981). Creativity as a construct in personal theory. *Journal of Creative Behavior, 15*(1). 43-66. https://doi.org/10.1002/j.2162-6057.1981.tb00273.x.

Worku, H., & Alemu, M. (2021). Supportiveness of existing classroom culture to the implementation of dialogic teaching: Analysis of teacher-student interaction in Physics teaching and learning. *Pedagogical Research, 6*(3), em0100. https://doi.org/10.29333/pr/11062.

Wright, B. D. (1997). A history of social science measurement. Educational Measurement: Issues and Practice, 16(4), 33-45.

Wu, H. Y., Wu, H. S., Chen, I. S., & Chen, H. C. (2014). Exploring the critical influential factors of creativity for college students: a multiple criteria decision-making approach. *Thinking Skills and Creativity, 11*, 1–21. DOI: 10.1016/j.tsc.2013.09.004.

Zheng, R.-c., & Xiao, B.-l. (1983). A study on the creativity of high school students. *Acta Psychologica Sinica*, *15*(4), 445–452.

Zimmerman, B.J. (2001). Theories of Self-Regulated Learning and Academic Achievement: An Overview and Analysis. In Zimmerman, B.J. & Schunk, D.H. (Ed.), *Self-Regulated Learning and Academic Achievement: Theoretical Perspectives* (pp. 1-65). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Level-1 Model

$$Y_{ij} = \beta_{0j} + \beta_{1j}*(\text{male}_{ij}) + \beta_{2j}*(\text{Regulations}_{ij}) + \beta_{3j}*(Peer_{ij}) + \beta_{4j}*(P\_relationship_{ij}) + \beta_{5j}*(P\_authoritarian_{ij}) + \beta_{6j}*(\text{P\_autonomy-supoort}_{ij}) + \beta_{7j}*(Achievement_{ij}) + \beta_{8j}*(Extrinsic\ motivation_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(T\_relationship_j) + \gamma_{02}*(T\_PRESS_j) + \gamma_{03}*(T\_methods_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(T\_relationship_j) + \gamma_{12}*(T\_PRESS_j) + \gamma_{13}*(T\_methods_j) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}*(T\_relationship_j) + \gamma_{22}*(T\_PRESS_j) + \gamma_{23}*(T\_methods_j) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}*(T\_relationship_j) + \gamma_{32}*(T\_PRESS_j) + \gamma_{33}*(T\_methods_j) + u_{3j}$$

$$\beta_{4j} = \gamma_{40+} \gamma_{41}*(T\_relationship_j) + \gamma_{42}*(T\_PRESS_j) + \gamma_{43}*(T\_methods_j) + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51}*(T\_relationship_j) + \gamma_{52}*(T\_PRESS_j) + \gamma_{53}*(T\_methods_j) + u_{5j}$$

$$\beta_{6j} = \gamma_{60} + \gamma_{61}*(T\_relationship_j) + \gamma_{62}*(T\_PRESS_j) + \gamma_{63}*(T\_methods_j) + u_{6j}$$

$$\beta_{7j} = \gamma_{70} + \gamma_{71}*(T\_relationship_j) + \gamma_{72}*(T\_PRESS_j) + \gamma_{73}*(T\_methods_j) + u_{7j}$$

$$\beta_{8j} = \gamma_{80} + \gamma_{81}*(T\_relationship_j) + \gamma_{82}*(T\_PRESS_j) + \gamma_{83}*(T\_methods_j) + u_{8j}$$

Y_{ij}: creativity of a child i's in school j

β_{0j}: school j's mean creativity after controlling for all the variables in the model.

β_{1j}: effect of gender (male) associated with creativity after controlling for all the variables in the model

γ_{00} : grandmean of creativity

γ_{10}: overall effect of boys associated with creativity

γ_{03}: overall effect of teachers teaching methods on creativity

γ_{11} : interaction effect between gender and students' relationship with teacher on creativity

γ_{21} : interaction effect between relationship with a teacher and self-regulation

;

$r_{ij} \sim N(0, \sigma^2_e)$ – individual child's unique effect associated with creativity after controlling for all the variables in the model.

$u_{0j} \sim N(0, \tau_{00})$ - school j's unique effect associated with creativity after controlling for all the variables in the model.

All variables in the model are grandmean-centered except for gender.

Figure 1. An intended two-level hierarchical linear model
Note: The final model was modified.

Summary of the model specified

Level-1 Model

$$CREAT\_Y1_{ij} = \beta_{0j} + \beta_{1j}*(GENDER_{ij}) + \beta_{2j}*(REGUL) + \beta_{3j}*(ACHIEV_{ij}) + \beta_{4j}*(E\_MOTIV_{ij}) + \beta_{5j}*(PEER_{ij}) + \beta_{6j}*(P\_RELATION_{ij}) + \beta_{7j}*(P\_AUTHO_{ij}) + \beta_{8j}*(P\_AUTOS_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(T\_METHD_j) + \gamma_{02}*(T\_PRESS_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21}*(T\_METHD_j) + \gamma_{22}*(T\_PRESS_j) + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31}*(T\_METHD_j) + \gamma_{32}*(T\_PRESS_j) + u_{3j}$$
$$\beta_{4j} = \gamma_{40}$$
$$\beta_{5j} = \gamma_{50} + \gamma_{51}*(T\_METHD_j) + \gamma_{52}*(T\_PRESS_j) + u_{5j}$$
$$\beta_{6j} = \gamma_{60}$$
$$\beta_{7j} = \gamma_{70}$$
$$\beta_{8j} = \gamma_{80} + \gamma_{81}*(T\_METHD_j) + \gamma_{82}*(T\_PRESS_j) + u_{8j}$$

REGUL ACHIEV, EXTRIN_MOTIV, PEER, P_RELATION, P_AUTH, and P_AUTOS have been centered around the grand mean.

T_METHD1, T_PRESS1 are centered around the grand mean.

Figure 2. A final model-1 hierarchical linear model with GENDER (Gender), REGUL (Self-regulation), ACHIEV (Achievement), E_MOTIV (Extrinsic Motivation), PEER (Peer relations), P_AUTHO (Authoritarian parenting style), P_AUTOS (Autonomous parenting style).

Note: In final model-2, instead of using T_METHD (teaching method) and T_PRESS (teacher pressure), we used T_PRESS (teacher pressure) and T_REL (teacher relationship), which was represented in Table 8.

Table 1. Variables constructed and coefficient alpha

Variable	alpha (α)	N	Content
Creativity	0.878	5	① I can figure out things that many friends cannot; ② I can think of things that can be helpful in solving new problems; ③ I can imagine the whole content even if I hear only a part of it; ④ I can make things connected each other even though they appear unrelated; ⑤ I can find many new ideas in a short time
Self-regulation	0.807	5	① I plan things before undertaking whenever I have plenty to do; ② I do not procrastinate on what I need to do today; ③ I check my planner/notice book and do not miss things that I need to do today; ④ I organize and clean my desk by myself; ⑤ I myself prepare/bring out things for school to work.
Extrinsic motivation	0.818	6	① I study because my parents are angry; ② I study because my parents give me prizes (e.g. pocket money, gifts, compliments, etc.); ③I study because the teacher rewards or praises me; ④If I don't study, the teacher punishes me, so study; ⑤ I study because my parents tell me to do it; ⑥I study because the teacher tells you to do it
Peer relations	0.914	6	Friendship relationship - peer attachment: ① My friends respect my thoughts when talking with me; ② My friends listen to what I say; ③ I tell my friends about my worries and problems; ④ My friends understand me well; ⑤ I can tell my friends when I want to confide in my heart; ⑥ I trust my friends.
P_relation	0.786	4	① My parents are concerned about me and ask questions regarding my school life; ② They respond to my questions kindly no matter how tedious they are; ③ They play games with me; ④ They read books together and talk.
P_authoritarian	0.712	2	① Parents ordered me to follow their words/what they say; ② Parents interfere with my work/small things.
P_autonomy support	0.772	2	① Parents respect my decision; ② Parents allow me to choose what I want to do.
T_methods	0.931	8	① Teachers are well aware of my strengths and weaknesses; ② Teachers check my level of

			understanding in class; ③ Teachers give assignments according to my abilities; ④ Teachers explain according to my level.⑤ Teachers frequently praise me as a means to encourage me to study more; ⑥ Teachers encourage me to challenge even a slightly difficult problem; ⑦ Teachers give me ample opportunities to present myself in class; ⑧ When I ask questions that I do not understand, my teachers kindly explain things again until I understand.
T_pressure	0.718	4	② Teachers dislike students if they do not study hard; ③ My teacher emphasizes that our class should excel in the tests; ④ My teacher emphasizes that all students should complete their homework.
T_relations	0.925	5	① My teacher listens to me well; ② My teacher calls my name kindly; ③ When I say hello, my teacher greats me kindly; ④ My teacher often praises me; ⑤ My teacher knows me well.

Note. Peer_relations, P_relations, T_methods, T_pressure, and T_relations stand for peer relations (attachment), parents' relationship with their children, teachers' interactive teaching methods, teachers' academic pressure, and children's perceived relationships with teachers, respectively. The circled numbers are the item given by the KELS2013. P_authoritarian and P_autonomy represent authoritarian and autonomy-supportive parenting styles, respectively; these two variables are used for Level 2.

Table 2. Result of Rasch measurement analysis

Variable	Variance	Eigen Value	Percent (%)	PCA Disattenuated Correlation	Infit Range	Outfit Range	Pt-biserial correlation Range	DIF (gender)	Item.Sep Index (Reliability)	Per.Sep Index (Reliability)
Creativity	Total	12.792	100.00	0.91-1	.91~1.12	.91~1.11	.78~.83	NA	2.30(.83)	2.19(.83)
	Model	7.792	60.90							
	Person	6.509	50.90							
	Item	1.283	10.00							
	Unexplained	5.000	39.10							
	1st Contrast	1.419	11.10							
Self-regulation	Total	10.993	100.00	.76~.1.0	.86~1.16	.85~1.16	.71~.79	NA	1.79(.76)	31.17(1.0)
	Model	5.993	54.50							
	Person	3.560	32.40							
	Item	2.434	22.10							
	Tot Unexplained	5.000	45.50							
	1st Contrast	1.571	14.30							
Extrinsic motivation	Total	8.730	100.00	.99~1.0	.97~1.09	.98~1.12	.74~.87	NA	1.39(.66)	31.11(1.0)
	Model	4.730	54.20							
	Person	2.922	33.50							
	Item	1.808	20.70							
	Unexplained	4.000	45.80							
	1st Contrast	1.549	17.70							
Peer_relations	Total	15.527	100.00	.77~1.0	.65~1.35	.64~.134	.76~.87	NA	2.42(.85)	27.03(1.0)
	Model	9.527	61.40							
	Person	7.118	45.80							
	Item	2.409	15.50							

	Unexplained	6.000	38.60							
	1st Contrast	1.958	12.60							
P_relations	Total	10.247	100.00	.63~1.0	.99~1.11	.98~1.11	.71~.81	NA	1.74(.75)	52.16(1.0)
	Model	6.248	61.10							
	Person	3.270	31.90							
	Item	2.977	29.10							
	Unexplained	4.0000	39.00							
	1st Contrast	1.19	11.70							
P_authoritarian	Total	5.887	100.00	NA	.98~1.0	1.97~1.0	.88~.88	NA	1.63(.73)	27.34(1.0)
	Model	3.887	66.27							
	Person	3.183	54.10							
	Item	0.704	12.00							
	Unexplained	2.000	34.00							
	1st Contrast	0.001	0.00							
P_autonomy	Total	6.136	100.00	NA	.97~1.01	.96~1.00	.90~.90	NA	1.62(.72)	24.87(1.0)
	Model	4.136	67.40							
	Person	3.479	56.70							
	Item	0.657	10.70							
	Unexplained	2.000	32.60							
	1st Contrast	0.001	0.00							
	1st Contrast	1.966	19.20	.67~1.0	.86~1.34	.84~1.38	.46~.76	NA	1.74(.75)	52.16(1.0)
T_press	Total	10.667	100.00							
	Model	6.667	62.50							
	Person	3.030	28.40							
	Item	3.637	34.10							
	Unexplained	4.000	37.50							

	1st Contrast	1.573	14.70							
T_Methods	Total	19.728	100.00	.82~1.0	.84~1.13	.84~1.15	.77~.84	NA	2.44(.86)	16.43(1.0)
	Model	11.738	59.00							
	Person	8.298	42.00							
	Item	3.429	17.00							
	Unexplained	8.000	41.00							
	1st Contrast	2.046	10.00							
T_Relations	Total	15.237	100.00	.92~1.0	.92~1.25	.91~1.21	.85~.89	-.56 Female	2.48(.86)	27..03(1.0)
	Model	10.237	67.20							
	Person	8.280	54.30							
	Item	1.957	12.80							
	Unexplained	5.000	32.80							
	1st Contrast	1.513	9.90							

Note. NA represents practically insignificant DIF (< .43 logit). There was a mild DIF in T_Relations and females are more likely to agree with the items than males.

All items that constitute respective construct/variable showed unidimensionality as was shown lower than 2 in the 1st contrast and mostly high disattenuated correlations between clustered items.

Table 3. Unconditional Model

Fixed Effect	Coefficient	SE	*t*	*df*	*p*
INTRCPT2, γ_{00}	3.484	0.017	210.575	239	< 0.001
Random Effect	*SD*	Variance	*df*	χ^2	*p-value*
INTRCPT1, u_0	0.205	0.042	239	765.914	< 0.001
level-1, *r*	0.748	0.559			

Table 4. Effect of child characteristics and parenting style on student's creativity

Fixed Effect	Coefficient	*SE*	*t*	*df*	*p*	*β*
INTRCPT1	3.377	0.013	254.817	239.000	<0.001	
Gender, γ_{10}	0.232	0.017	13.787	239.000	<0.001	0.151
Self_regulation, γ_{20}	0.284	0.014	20.714	239.000	<0.001	0.277
Achievement, γ_{30}	0.005	0.000	18.541	239.000	<0.001	0.206
Extrin_motivation, γ_{40}	-0.006	0.013	-0.487	239.000	0.627	-0.005
Peer relations, γ_{50}	0.187	0.012	15.348	239.000	<0.001	0.204
P_relations, γ_{60}	0.121	0.012	10.185	239.000	<0.001	0.138
P_authoritarian, γ_{70}	0.032	0.009	3.7	239.000	<0.001	0.040
P_autonomous, γ_{80}	0.036	0.011	3.269	239.000	0.001	0.042
Random Effect	SD	Variance	df	χ^2	*p*	
INTRCPT1, u_0	0.116	0.014	201	256.533	0.005	
Gender, u_1	0.110	0.012	201	230.980	0.072	
Self_regulation, u_2	0.103	0.011	201	242.946	0.023	
Achievement, u_3	0.002	0.000	201	245.836	0.017	
Extrin motivation, u_4	0.062	0.004	201	216.654	0.214	
Peer relations, u_5	0.094	0.009	201	262.990	0.002	
P_relationship, u_6	0.086	0.007	201	234.688	0.052	
P_authoritarian, u_7	0.047	0.002	201	200.237	>0.500	
P_autonomous, u_8	0.074	0.006	201	251.956	0.009	

Note. Extrin_motivation stands for extrinsic motivation.

Table 5. Correlation Table

	①	②	③	④	⑤	⑥	⑦	⑧
① Creativity	1							
② Self_regulation	.451**	1						
③ Achievement	.303**	.218**	1					
④ Extrin_motiv	-.191**	-.305**	-.198**	1				
⑤ Peer_relations	.403**	.418**	.187**	-.210**	1			
⑥ P_relation	.349**	.360**	.144**	-.253**	.366**	1		
⑦ P_authori	-.051**	-.097**	-.127**	.308**	-.106**	-.176**	1	
⑧ P_autos	.251**	.294**	.120**	-.260**	.267**	.475**	-.254**	1
Gender	.057**	-.141**	-.126**	.089**	-.110**	-.030*	.126**	-.074**

Variable	T_method	T_press	T_relation
T_method	1		
T_press	.196**	1	
T_relationship	.897**	.164*	1

Note. Extrin_motiv and Peer_relations stand for extrinsic motivation and relationship with peers (peer-attachment) each.

Table 6. Final model-1

Fixed Effect	Coefficient	SE	*t*	*df*	*p*	*β*
INTRCPT2, γ_{00}	3.379	0.013	258.833	237	<0.001	
T_method, γ_{01}	0.089	0.035	2.533	237	0.012	0.038
T_press, γ_{02}	0.070	0.039	1.794	237	0.074	0.024
Gender, γ_{10}	0.231	0.017	13.647	5851	<0.001	0.150
Self-regulation, γ_{20}	0.286	0.014	20.632	237	<0.001	0.279
T_methods, γ_{21}	-0.048	0.043	-1.12	237	0.264	-0.021
T_press, γ_{22}	-0.016	0.053	-0.297	237	0.767	-0.005
Achievement, γ_{30}	0.005	0.000	17.928	237	<0.001	0.201
T_method, γ_{31}	-0.001	0.001	-1.273	237	0.204	0.000
T_press, γ_{32}	0.002	0.001	1.578	237	0.116	0.001
Extrinsic_motivation, γ_{40}	-0.004	0.013	-0.326	5851	0.744	-0.004
Peer, γ_{50}	0.185	0.012	15.327	237	<0.001	0.202
T_method, γ_{51}	0.022	0.041	0.531	237	0.596	0.009
T_press, γ_{52}	-0.076	0.048	-1.597	237	0.111	-0.026
P_relations, γ_{60}	0.117	0.012	9.844	5851	<0.001	0.128
Authoritarian, γ_{70}	0.031	0.009	3.518	5851	<0.001	0.038
Autonomous, γ_{80}	0.037	0.011	3.385	237	<0.001	0.043
T_method, γ_{81}	0.040	0.037	1.092	237	0.276	0.017
T_press, γ_{82}	-0.028	0.044	-0.625	237	0.533	-0.009

Random Effect	SD	Variance	*df*	χ^2	*p*
INTRCPT1, u_0	0.079	0.006	228	287.9982	0.005
Self_regulation, u_2	0.084	0.007	228	263.9021	0.051
Achievement, u_3	0.002	0.000	228	257.0657	0.091
Peer_relations, u_5	0.095	0.009	228	287.1091	0.005
Autonomous, u_8	0.062	0.004	228	282.0615	0.009
level-1, *r*	0.615	0.378			

Note. T_method represents a teacher's student-centered teaching methods and T_press represents students' perceptions of their teacher's concern about academic activities/achievement.

Table 7. Final Model-2

Fixed Effect	Coefficient	*SE*	*t*	*df*	*p*	*β*
INTRCPT2, γ_{00}	3.378	0.013	262.859	237	<0.001	
T_press, γ_{01}	0.064	0.038	1.697	237	0.091	0.022
T_relation, γ_{02}	0.133	0.033	4.02	237	<0.001	0.057
Gender, γ_{10}	0.231	0.017	13.607	5851	<0.001	0.150
Regulation, γ_{20}	0.285	0.014	20.589	237	<0.001	0.278
T_press, γ_{21}	-0.026	0.052	-0.497	237	0.620	-0.009
T_relation, γ_{22}	-0.014	0.041	-0.349	237	0.728	-0.006
Achievement, γ_{30}	0.005	0.000	18.034	237	<0.001	0.200
T_press, γ_{31}	0.002	0.001	1.596	237	0.112	0.001
T_relation, γ_{32}	-0.001	0.001	-1.459	237	0.146	-0.001
Extrinsic motivation, γ_{40}	-0.003	0.013	-0.247	5851	0.805	-0.003
Peer_relations, γ_{50}	0.184	0.012	15.147	237	<0.001	0.201
T_press, γ_{51}	-0.074	0.048	-1.555	237	0.121	-0.025
T_relation, γ_{52}	0.018	0.042	0.436	237	0.664	0.008
P_relations, γ_{60}	0.117	0.012	9.848	5851	<0.001	0.134
Authoritarian γ_{70}	0.031	0.009	3.558	5851	<0.001	0.039
Autonomous γ_{80}	0.037	0.011	3.379	237	<0.001	0.043
T_press, γ_{81}	-0.025	0.045	-0.56	237	0.576	-0.008
T_relation, γ_{82}	0.038	0.033	1.13	237	0.260	0.016
Random Effect	SD	Variance	*df*	χ^2	*p*	
INTRCPT1, u_0	0.074	0.005	228	277.802	0.013	
Self-regulation, u_2	0.084	0.007	228	264.559	0.048	
Achievement, u_3	0.001	0.000	228	255.893	0.099	
Peer_relations, u_5	0.095	0.009	228	286.647	0.005	
Autonomous, u_8	0.062	0.004	228	281.721	0.009	
level-1, *r*	0.615	0.378				

Note. T_press represent a teacher's student-centered teaching methods and T_relation represents students' perceptions of their relationship with their teacher.