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## Effect of Intrinsic Motivation on Junior High School Students' Creativity: Mediating Role of Cognitive Flexibility

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**Abstract:** This research's aim was to explore the role of cognitive flexibility in mediating the effect of intrinsic motivation on the creativity of junior high school students. A creativity scale, an intrinsic motivation inventory and a cognitive flexibility inventory were utilized to investigate a sample of junior high school students in Shaanxi Province in western China. 765 valid questionnaires were collected and analyzed using the structural equation model (SEM). The SEM analysis showed that intrinsic motivation and cognitive flexibility have significantly positive impacts on junior high school students' creativity. Furthermore, a full model revealed that cognitive alternatives and cognitive control mediate the relationship intrinsic motivation and creativity, and the mediation effect of cognitive alternatives is significantly greater than that of cognitive control. In general, the current research suggests that the impact of intrinsic motivation on junior high school students' creativity is mediated by cognitive flexibility, and its results amplify prior scholars' research results and give educators an inspiration how to cultivate creativity for the middle school students.

**Keywords:** Cognitive flexibility, creativity, intrinsic motivation.

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### Introduction

Creativity is the driving force of scientific progress and social development and the core means of competitiveness of all countries (Heinze et al., 2009a). There is a growing tendency to incorporate the research of creativity in the educational system in response to the need to cultivate creative talents for social and economic development (Sawyer, 2006). In the classroom, cultivating students' creativity can make many advantageous and long-time continuous effects that support students on their way to growing up as adults who are critical thinkers and risk-takers (Csikszentmihalyi, 2013; Hennessey, 2017; Starko, 2017). According to Sternberg's research, adolescence is a vital stage for cultivating creativity (Sternberg, 2007). Florida (2002) observes that creativity has gradually become one of the core competences required by teenagers who dream of succeeding in the contemporary knowledge economy. Fostering the creativity of teenagers is an essential task for schools (Albari et al., 2013).

Although it is evident that fostering teenagers' creativity is an essential task for schools, compulsory education and the education system in many countries are heavily criticized for hindering the development of students' creativity. In their study, Cho et al. (2017) refer to a longstanding and compelling body of literature, in which concern is expressed that the development of students' creativity in a K-12 educational setting has been threatened to the point that it is now deteriorating at an alarming rate (Beghetto, 2010; Berliner, 2009). China's traditional teaching style is also criticized more and more, with teachers accused of generally failing to develop students' creativity, while Chinese educators blame traditional Chinese education for strangling it (Wang & Yang, 2010). Since Chinese students were being severely criticized by the news media for sacrificing their creativity and imagination for the sake of a high academic performance (Stack, 2011), the Chinese government determined that the focus of education in the classroom must be the cultivation of students' ability to innovate (Gu, 2010). This demonstrates the increasing concern about the fostering students' creativity and the lack of the traditional teaching style transformation in the field of educational study and practice in China. Hence, this research aims to test the extent of creativity of junior high school students in China and identify the factors affecting creativity.

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The Componential Theory of Creativity (CTC) proposed by Amabile (1988) emphasizes that intrinsic motivation (IM) is a central component of individuals that influences their creativity. Individuals are at optimal creativity when they involve in an activity because of the involvement, pleasure, satisfaction, and challenge for the action itself, rather than rewards, surveillance, competition, or evaluation. Some researchers have discovered that IM is vital for creativity (Eisenberger & Aselage, 2009; Shin & Zhou, 2003), and it is a kind of energy to drive individuals to be enquiring and adventurous, meet challenges, break with convention (McGraw & Fiala, 1982), thereby stimulating creativity (Shin & Zhou, 2003).

Nevertheless, the findings of empirical studies of the relationship between IM and individuals' creativity are mixed (Shalley et al., 2004). The previous studies found that IM has a weak or even insignificant effect on creativity (Shalley & Perry-Smith, 2001). Specifically, when they tested the relationship between expected evaluation, IM and creativity, and found that expected evaluation and IM had a significant and positive effect on creativity. However, when putting intrinsic motivation and expected evaluation concurrently into a regression model, the analysis result showed that IM had an insignificant effect on creativity. These results imply that predictive role of IM on creativity may be mediated by other variables. According to George (2007), the association between IM and creativity should not be taken for granted but should be explored more deeply. Scholars believe that empirical evidence linking IM and creativity is still ambiguous (Grant & Berry, 2011). Clarifying the underlying mechanisms between IM and creativity can enable researchers to acquire a comprehensive understanding for the influence of IM on creativity (Li et al., 2018). Hence, one of the purposes in the study is to explore the indirect effect of IM on creativity.

Although scholars commonly concur that creativity is viewed as an ability to make valuable and novel products (Plucker et al., 2004; Runco & Jaeger, 2012; Sternberg & Robert, 2005), neurocognitive mechanisms remain elusive, mainly because creative cognition is likely to involve complex cognitive processes (Jung et al., 2010). It is also noted that other variables may mediate the influence of IM on creativity. Researchers who have explored creativity in cognitive science have found that creativity generally starts with creative thinking, which has three characteristics, namely, fluency, flexibility, and originality (Kim et al., 2006; Vartanian, 2009). According to the literature, cognitive flexibility (CF) is defined as individuals' ability to freely switch their cognition of different stimuli or environmental changes (Dennis & Vander Wal, 2010). It is essential to develop new ideas, change or establish unusual connections between things, and demonstrate broad cognitive classification for people. Empirical studies have revealed a positive correlation between CF and creativity (Chen et al., 2014; Nijstad et al., 2010). Some empirical researchers have found that intrinsic motivation can expand individuals' attention boundary and increase their openness to new ideas or experiences. Individuals become more creative by devoting themselves to creative processes, which involves exploring new methods, establishing associations that are unusual, but relevant (Fredrickson, 1998; Zhang & Bartol, 2010) and exhibiting an unconventional and inclusive classification structure (Murray et al., 1990), which represents the performance of CF. Therefore, based on this theoretical path, empirical methods are utilized in this study to determine whether CF plays a mediation role between IM and creativity. Hence, the aim of the research is three-fold: (1) to analyze the effect of IM on junior high school students' creativity; (2) to explore the effect of CF on creativity; and (3) to verify indirect effect of IM on creativity through CF.

## Literature Review

### *Intrinsic Motivation and Creativity*

The contemporary research on creativity emphasizes the huge controversy among scholars in relation to its definition. Creativity was regarded as a unique genetic ability when researchers focused on exceptional creative talents. However, contemporary creativity was popularized in a speech by Gulliford when he became Chairman of the American Psychological Association (Feldman & Benjamin, 2006). Since then, it has been regarded as a psychological trait possessed by everyone, which can be developed and evaluated. Silvia et al. (2012) point out that the definitions of creativity are usually based on different theoretical structures, which can be divided into four categories, namely, products of creativity, process of creativity, individual differences of creativity, and the socio-psychology of creativity. Plucker et al. (2004) define creativity as individuals' knowledge and capabilities to produce new, original, surprising, and valuable products. Runco and Chand (1995) proposed that the creative process was once deemed to consist of divergent thinking entirely, but researchers later realized that it includes divergent thinking and cognitive processes like aggregated thinking and associative thinking (Cropley, 1997; Runco, 2007). Its socio-psychology orientation is focused on socio-environmental characteristics that promote or hinder creativity (Dul & Ceylan, 2011; Simonton, 2003), and the study about individual differences of creativity mainly paid attention on the iconic characteristics of extremely creative individuals, such as their personality, motivation, interest, attitude, etc., which are different from those of ordinary people (Kim et al., 2010; Prabhu et al., 2008; Runco, 2019; Sarathy, 2018). Its product orientation is mainly based on the evaluation and prediction of creativity from a product perspective (Paul & Kaufman, 2014; Shalley et al., 2004; Sternberg, 2007; Walia, 2019; Zhou & George, 2001), and Sternberg (2007) regarded creativity as the capability to create new and useful ideas, products, or processes.

Intrinsic motivation (IM) is an individual's desire to expend energy on a specific activity out of interest (Ryan & Deci, 2000b). Ryan and Deci (2000c) states that individual has a natural tendency to exercise their ability, seek challenges,

explore, and master knowledge, which is the characteristic of intrinsic motivation. Meanwhile, Amabile described the main components of IM involved competence, self-determination, integration, and curiosity (Amabile, 1993). In their study, Deci and Ryan (1985) propose that the core elements to stimulate IM are to meet the basic psychological need for autonomy, competence and relatedness. According to Saether (2020), fulfilment of basic psychological needs precedes positive affect, which leads to intrinsic motivation and creativity.

Some empirical researchers have confirmed that intrinsic motivation helps individuals to achieve creative results in different situations (Bodla & Naeem, 2014; Wang et al., 2021; Zhang & Bartol, 2010; Zhang & Gheibi, 2015). Sternberg and Lubart (1996) proposed that intrinsic and task-centered motivation increase individuals' creativity. Runco et al. (1998) investigated 143 researchers with more creative performance and concluded that IM had affected their creative performance. Prabhu et al. (2008) took 124 college students as samples and found that intrinsic motivation significantly affected their creativity. Gu et al. (2015) investigated IM of 216 college students in China, and found that IM had a significant impact on their creativity. Wang et al. (2021) found that senior high school students' IM positively correlated with their creativity. Based on the above empirical research, hypothesis H1 is proposed: IM is a significant predictor of junior high school students' creativity.

### *Cognitive Flexibility and Creativity*

It was found from a review of the literature that cognitive flexibility (CF) refers to cognitive ability and cognitive processes or systems. According to Diamond (2006), CF is the ability to freely switch the attention or reaction pattern, while Colzato et al. (2009) described CF as a specific cognition capability or skill and individuals who are able to freely change their cognition in response to different stimuli or changes of environment can be deemed to possess CF. Researchers observed that CF is the capability to adjust goal-directed behaviors to accommodate to the environment changes (Garcia-Garcia et al., 2010). These researchers have all concluded that cognitive flexibility has the attribute of cognitive control (Ionescu, 2012), while others have suggested that CF is the result of various cognitive processes (Martin & Rubin, 1995) or cognitive systems (Deák, 2003). Martin and Rubin (1995) propose that CF is a characteristic embedded in individuals' cognition of social situations, which enables them to use alternative methods to deal with conflict. Some scholars have studied cognitive flexibility from the perspective of flexible behavior (Crone et al., 2006; Goldstone & Landy, 2010; Leber et al., 2008), for example, the ability to switch from one task to another or so-called multitasking, to change behavior in response to new rules, find new solutions to old problems, or create new knowledge or tools. These definitions of cognitive flexibility demonstrate optional attributes of cognition (Ionescu, 2012). Cognitive flexibility is measured in this study by a two-dimensional scale of cognitive alternatives and cognitive control.

The dual pathway model of creativity developed by De Dreu et al. (2008) verified that creativity is a function of cognitive flexibility and persistence, and it may be affected by dispositional or situational variables via flexibility and persistence. The creativity's flexibility pathway indicates to achieve creative insights, solve problems, or have a new idea via remote, rather than proximal associations, extensive and inclusive cognitive categories, and adaptable shifting among categories (Eysenck, 1993). Creativity is generally connected with generating new contacts among distal ideas (Simonton, 1999), and with "breaking sets" or overcoming "functional fixedness" (Smith & Blankenship, 1991). It requires people to not only depend on creative thinking and flexible strategies but instead, to focus on a wide range of methods and switch flexibly between them when undertaking tasks (Ashby et al., 1999). To summarize, CF may have a critical influence on creativity.

De Dreu et al. (2011b) consider that CF is the ability to adapt one's thoughts and behaviours, and proposes that it could arouse individuals' creativity due to being embodied in a destructive process of cognition, cognitive reorganization, and an association with different things. Carson et al. (2005) connect higher CF with better creative performance, while other scholars define CF as the cognitive core of creativity and a central element in "real life" creativity (Beghetto & Kaufman, 2007). Therefore, the second hypothesis (H2) is proposed: cognitive flexibility has a positive effect on creativity. Specifically, hypothesis H2 consists of two sub-hypotheses: a) cognitive alternatives (CA) of CF have a positive influence on creativity; b) cognitive control (CC) of CF has a positive influence on creativity.

### *Relationship between Intrinsic Motivation, Cognitive Flexibility and Creativity*

The Componential Theory of Creativity (Amabile, 1988) is the fundamental theory of this study. Amabile (1998) summarized the within-individual and without-individual components that affect creativity and highlighted the effect of without-individual components on cognitive style and intrinsic motivation on creativity. Flexibility is one of the features defining human cognition (Braver et al., 2009; Jacques & Zelazo, 2005). CF allows individuals to rapidly adapt their thoughts and behaviors to changing environmental needs and goals (Chevalier et al., 2012). In childhood, CF is generally viewed as a key characteristic of successful cognition (Ionescu, 2012) amplified by executive functions (Garon et al., 2008).

According to the Self-Determination Theory, IM is an energy that drives individuals to maintain certain behavior or conduct specific tasks in order to fulfil their innate need for competence, autonomy and relatedness (Deci & Ryan,

2000a). For Shalley et al. (2004), their study found that individuals' IM enhances their creativity by promoting their positive emotions, flexible cognition, risk-taking behaviors. Intrinsic motivation urges people to focus on their desire to explore or learn new things, and it promotes creativity by enhancing their openness to experiences and ideas (Fredrickson, 1998), which is the manifestation of cognitive flexibility.

Ryan and Deci (2000b) maintain that employees' desire to explore and challenge is ignited when they are highly intrinsically motivated. Therefore, employees when they are at higher level of intrinsic motivation tend to pay their attention on innovative activities (Zhang & Bartol, 2010), for example, building unusual associations among all kinds of things (Isen et al., 1992), thereby setting up inclusive categorization structures. Based on this theoretical assumption, Li et al. (2018) affirm that CF plays a mediating role between IM and employees' creativity. This leads to the proposal of H3: IM has an indirect influence on creativity through cognitive flexibility. Specifically, H3a is that the cognitive alternatives of CF plays a mediating role between IM and creativity and H3b is that the cognitive control of CF plays a mediation role between of IM on creativity.

## Methodology

### Research Design

The participants are junior high school students in the 7th to 9th grades in Shaanxi Province, China. The purpose of the study is to explore the effect of intrinsic motivation on creativity, and the mediating effect of cognitive alternatives and control of cognitive flexibility. The framework of the study is shown in Figure 1.

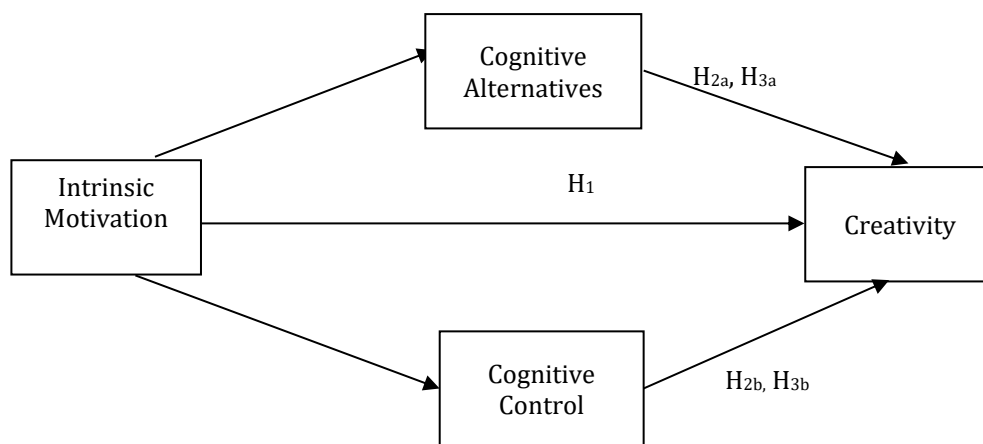


Figure 1. Research Framework

### Sample and Data Collection

The participants are from four junior high schools. The data for the pilot study was collected from Chaoyang and Duqiao junior middle-schools in Weinan City of Shaanxi Province. 241 of the total 267 questionnaires retrieved were valid, giving an effective rate of 90%.

Cluster sampling was used for the formal research to examine students from 24 classes as samples of different grades of four schools located in Xi'an, Baoji, Xianyang and Weinan, respectively. Schools A and B are located in the rural areas of Baoji and Xianyang respectively, and schools C and D are located in the urban areas of Weinan and Xi'an, respectively. The data was also collected online and, after the sample was extracted, the teaching supervisors of each school sent the questionnaire link and video to the QQ group of the sample class and guided the students to watch the video and complete the questionnaire. Since the questionnaire could only be submitted after the student had answered all the questions, there were no missing answers. The students could draw a red envelope as a reward after completing the questionnaire in order to improve the participation rate. The questionnaire platform prohibits students from sharing scales and possesses an IP identification function that prevents repeated replies or answers from students in non-sample groups. 846 samples were collected from the formal survey and, after diagnosing the extreme value, kurtosis and skewness of the data distribution, 765 valid questionnaires were obtained, giving an effective rate of 90%. 187 of the participants were from Baoji, 197 from Xianyang, 165 from Weinan, and 216 from Xi'an. The demographic details of the sample who completed the valid questionnaires are shown in Table 1. There were 392 males and 373 females in the sample, accounting for 51.2% and 48.8% of the total number. Students in the seventh, eighth and ninth grades accounted for 26.0%, 45.9%, and 28.1% of the overall samples. The participants were between 11 and 17 years old, and the 13-15 years old accounted for 86.4% of the total sample size. The families of 351 of the 765 samples lived in rural areas, and those of the remaining 414 students lived in cities.

Table 1. Distribution of demographic variables of sample (n=765)

NO.	Demographic Characteristics	Total	%	Cumulative %
	<b>Gender</b>			
1	Male	392	51.2	51.2
	Female	373	48.8	100.0
	<b>Grade</b>			
2	Seven	199	26.0	26.0
	Eight	351	45.9	71.9
	Nine	215	28.1	100.0
	<b>Ages</b>			
3	11	16	2.1	2.1
	12	72	9.4	11.5
	13	260	34.0	45.5
	14	301	39.3	84.8
	15	100	13.1	97.9
	16	11	1.4	99.3
	17	5	0.7	100.0
	<b>School</b>			
4	A	187	24.4	24.4
	B	197	25.8	50.2
	C	165	21.6	71.8
	D	216	28.2	100.0
	<b>Region</b>			
5	Countryside	351	45.9	45.9
	City	414	54.1	100.0

#### Analyses of Reliability and Validity of Research Tools

The reliability and validity of the questionnaire were tested based on an internal consistency analysis and an exploratory factor analysis of the Intrinsic Motivation Inventory (IMI), Cognitive Flexibility Inventory (CFI), and creativity. A Confirmatory Factory Analysis (CFA) was conducted via structural equation modeling (SEM) to test the goodness of fit of every scale structure of the research data. The estimation of model parameters by the SEM technique is usually based on three assumptions: a) a large sample of above 200 (Hair et al., 2010), b) data normality, and c) no outliers. The normality and outliers of the data distribution were tested in this study before estimating the model parameters and all the skewness values of the observation variables were between +1 and -1, and the kurtosis values were between +1.5 and 0, indicating the univariate normality of the data (Das & Imon, 2016). The Mardia multivariate kurtosis value was 518.084 under  $p(p+2)$ , indicating a multivariate normal distribution of the dataset (Cain et al., 2016). The samples with outliers were screened using the SPSS and it was confirmed that the samples in the study are free of influential outliers.

#### (1) Intrinsic Motivation Inventory

The Intrinsic Motivation Inventory (IMI) developed by the Center for Self-Determination Theory (2021), was used in this study. The IMI has been used by previous researchers in several experiments related to IM and self-regulation (Deci et al., 1994; Zhou et al., 2009). Since Ryan and Deci (2000b) maintain that intrinsic motivation refers to individuals' desire to expend energy on an activity out of interest, the intrinsic motivation of the students in this study was assessed by the interest subscale of the IMI, which is a self-reporting measure of IM (Black & Deci, 2000). The interest subscale consists of six items, including "I enjoyed learning", "I thought learning was quite enjoyable", "I thought learning was a boring activity", and "Learning did not hold my attention at all", two of which are reverse scoring. All the items are measured by a 7-point Likert-type scales, ranging from 1 (strongly disagree) to 7 (strongly agree). Chinese versions of the interest subscale were created based on a back-translation procedure. The results of the reliability analysis of IMI revealed a Cronbach's  $\alpha$  coefficient of 0.92, which represents optimum reliability.

The CFA of the IMI showed factor loadings ranging from 0.77 to 0.89, and measurement errors ranging from 0.21 to 0.40 without a negative error variance. The  $\chi^2$  coefficient for the IMI was 27.58,  $\chi^2/df=3.07$ , RMSEA=0.05 (less than the criterion of 0.08), GFI=0.99, AGFI=0.97, NFI=0.99, CFI =0.99, TLI=0.99, IFI=0.97, all of which were higher than the minimum threshold of 0.9 recommended by scholars (Byrne, 2016; Hair, et al., 2018; Loehlin & Beaujean, 2017). These results show that the measurement model of IMI is a good fit with the research data. The Composite Reliability (CR) value of 0.947 for IMI indicates that this latent variable has excellent combination reliability. The AVE value of 0.749 is more than the required standard of 0.5, which shows good convergence validity.

### *(2) Cognitive Flexibility Inventory*

The Cognitive Flexibility Inventory (CFI) applied in this study is a 20-item self-reporting measure of CF involving two subscales: Cognitive alternatives (CA), which tests individual's abilities to find out alternative explanations under challenging circumstances and to propose various solutions, and cognitive control (CC), which assesses the extent of perceived difficult situations as controllable for a person (Dennis & Vander Wal, 2010). The CFI was used in this study to measure the junior high school students' cognitive flexibility. The respondents indicated the extent of similarity with each item using a 7-point Likert-type scales. Items 2,4,7,9,11, and 17 were given a reverse score, and items 15 and 17 were deleted via the item analysis, reliability and validity analysis. The Cronbach's  $\alpha$  coefficient for the CFI, CA, CC were 0.89, 0.83, and 0.85, respectively, indicating a high level of reliability.

Two factors were extracted from the exploratory factor analysis of the CFI, namely, the alternative factor and the control factor. A first-order CFA was used to test the CFI and the results showed that standardized factor loadings ranged from 0.63 to 0.82, and the measurement errors ranged from 0.326 to 0.575 without a negative error variance. The  $\chi^2$  coefficient for the CFI was 429.55,  $\chi^2/df=3.206$ , RMSEA=0.05, GFI=0.94, AGFI=0.92, NFI=0.94, CFI=0.96, TLI=0.96, IFI=0.96, all of which were higher than the criterion of 0.90. The goodness-of-fit indices confirmed that the CFI's measurement model was a good fit with the data set. The CRs of the alternative and control factors of the CFI were 0.924 and 0.885, respectively, proving that the CFI was extremely reliable. It is worth noting that the AVEs of the AS and CS were 0.484 and 0.608, respectively. Although the AVE of the AS was lower than the standard value of 0.5, Hair et al. (1998) refer to the relationship between the sample size and the AVE and emphasize that an AVE above 0.40 is acceptable when the sample size exceeds 350. The results of the AVE confirm that the CFI has better convergence validity. Therefore, the above analysis fully confirms that the data collected by the CFI fits well with the theoretical model, and there is sufficient evidence of its superior reliability and validity.

### *(3) Creativity Scale*

The students' creativity was measured by creativity scale (Zhou & George, 2001). It is a 13-item measure and each item is rated with a 7-point Likert-type scale (1 =not at all characteristic to 7 = very characteristic). Students were asked to report the degree to which they possess the characteristic described in each question (e.g., "Comes up with new and practical ideas to improve performance"; "Is not afraid to take risks"). Previous scholars who used this scale to assess students' creativity (Gu et al., 2015; Tsai et al., 2015) found a Cronbach's  $\alpha$  between 0.91 to 0.96. The standard translation and back-translation procedure were followed to create a Chinese version of the creativity scale in this study (Brislin, 1980) with a Cronbach's  $\alpha$  coefficient of 0.957.

In terms of the CFA, the factor loadings ranged from 0.64 to 0.89, and the measurement errors ranged from 0.21 to 0.59. The goodness of fit index gave the following values to test the construct validity of the scale:  $\chi^2 =272.71$ ,  $df=65$ ,  $\chi^2/df=4.187$ , RMSEA=0.06, GFI=0.95, AGFI=0.93, NFI=0.96, CFI=0.97, TLI=0.96, IFI=0.96. The CR and AVE of the creativity scale were 0.94, 0.54 respectively, proving that its reliability and validity were excellent.

## **Findings / Results**

### *Common Method Bias*

AMOS 24.0 software was used to analyze the data based on a CFA to check the fit of the data set with the measurement model. Harman's single factor score was applied to determine if common method bias had affected the data by entering all the constructs into a factor analysis and to examine if the items were loaded into one common factor (Podsakoff et al., 2003). The analysis result showed that the total variance of a single factor was 37%, less than 50%, suggesting that the data had not been affected by common method bias.

### *Descriptive statistics and Correlation Analyses among Variables*

Descriptive statistics and correlation analyses were applied to three variables, namely, IM, CF and creativity. The mean of intrinsic motivation, creativity, and two sub-dimensions of cognitive flexibility ranged from 4.42 to 5.10. The correlation coefficient between intrinsic motivation and creativity was 0.45, the correlation coefficient between intrinsic motivation and alternative sub-dimension of cognitive flexibility was 0.39, the correlation coefficient between intrinsic motivation and control sub-dimension of cognitive flexibility was 0.27, and the correlation coefficients between creativity and two sub-dimensions of cognitive flexibility were 0.68 and 0.35 respectively. The correlations of constructs were all statistically significant ( $p<.01$ ). These results indicate that junior high school students' creativity is positively correlated with their IM and CF.

### *Test of the Research Hypotheses*

The SEM is an essential statistical tool that is extensively used in scientific research fields such as management and psychology. The SEM can better control measurement errors and simultaneously construct complicated multivariate models to enable researchers to obtain more precise analytical results than a general regression analysis (Wang et al.,

2020). Since the SEM has been used as a statistical analysis tool in many studies, it was also used to verify the theoretical model in this study.

### (1) Goodness of Fit of the Overall Model

The most vital step of structural equation modeling involves evaluating the model's fit because the estimation of the model parameters relies on a prerequisite of excellent goodness-of-fit (Wang et al., 2020). The goodness-of-fit of the overall model was estimated by multiple indices as follows:  $\chi^2=1664.2$ ,  $\chi^2/df=2.6$ , RMSEA=0.05, SRMR=0.06, GFI=0.89, AGFI=0.88, NFI=0.91, CFI=0.94, TLI=0.94, IFI=0.94, which can be said to be at an adequate level (Hair et al., 2010).

### (2) Effect of Intrinsic Motivation, Cognitive Alternatives and Cognitive Control of Cognitive Flexibility on Creativity

Some scholars suggest using the Bootstrapping method, which is a cutting-edge technique, to evaluate the mediating effect (Hair et al., 2018; Preacher et al., 2007) since it does not need the assumption of normal distribution (Hayes, 2009). Therefore, Bootstrapping was used to test the mediating effect in this study. Based on the Bootstrap method proposed by Shrout and Bolger (2002), when the sample size is 765, 2000 samples should be randomly selected and a 95% confidence interval of the parameter should be estimated. If the 95% confidence interval of the indirect effect does not include zero, it shows that the mediating effect exists.

The results of the Bootstrap SEM analysis are presented in Table 2. The standardized coefficients for the effect of IM, CA, CC on creativity were 0.200 [0.128, 0.273], 0.570 [0.486,0.658], 0.132 [0.057,0.203], respectively, and with all p-values lower than 0.05, the confidence interval of the direct effect of IM, CA, and CC on creativity did not include zero. Hence, the SEM Full Model shown in Figure 2 suggests that IM, CA, and CC have a significant positive effect on the creativity of junior high school students, thereby validating hypotheses H1, H2a, H2b.

### (3) Mediating Effect of Cognitive Alternatives and Cognitive Control on the Relationship between Intrinsic motivation and Creativity

Using the Bootstrap method proposed by Shrout and Bolger (2002) to detect the mediating effect can improve the accuracy of the estimation. The indirect effect of CA on the relationship between IM and creativity was 0.222 (0.39\*0.57), and its 95% confidence interval [0.172, 0.278] did not include zero. The results indicate that CA has a mediating role between IM and junior high school students' creativity. The indirect effect of CC on the relationship between IM and creativity was 0.036 (0.27\*0.132) and its 95% confidence interval was [0.015,0.059]. This indicates that IM has an indirect relationship with creativity via CC. The direct effect of IM on creativity was 0.20, and its 95% confidence interval was [0.128, 0.273] and did not include zero. The total effect was 0.458 (0.20+0.222+0.036), and the 95% confidence interval [0.382, 0.532] did not cross zero. These results show that CA and CC play a partial mediating role between IM and creativity (seen Table 2, Figure 2), thereby confirming research hypotheses H3, H3a, H3b.

Moreover, it was found from a comparison of the mediating effect of CA and CC that the mediating effect of CA increased by 0.186 compared with CC, and the 95% confidence interval of the incremental effect was [0.127,0.248], excluding zero. These results indicated that the mediating role of CA was significantly greater than that of CC. According to Wen et al. (2005), the mediation effect can be assessed by the ratio of the mediating effect to the total effect. The size of the mediating effect of cognitive flexibility accounted for 56% of the total effect. Based on the multivariate correlation square of the dependent variable, creativity, the  $R^2$  value was 0.501, which indicated that intrinsic motivation and cognitive flexibility could explain 50.1% of the variation of creativity (Figure 2).

Table 2. Bootstrap SEM analysis of total, direct, and indirect effects

	St. estimator	Boot SE	p-value	Percentile 95% Confidence interval
<b>Direct effect</b>				
IM→Crt.	0.200	0.036	0.001	[0.128, 0.273]
IM →CA	0.390	0.044	0.001	[0.304, 0.474]
IM→ CC	0.270	0.039	0.001	[0.195,0.349]
CA →Crt.	0.570	0.043	0.001	[0.486,0.658]
CC→ Crt.	0.132	0.037	0.001	[0.057,0.203]
<b>Indirect effect</b>				
1.IM→CA→Crt.	0.222	0.028	0.001	[0.172,0.278]
2.IM→CC→Crt.	0.036	0.019	0.001	[0.015,0.059]
1-2	0.186	0.031	0.001	[0.127,0.248]
<b>Total effect</b>				
IM→ Crt.	0.458	0.038	0.001	[0.382,0.532]

Note. IM: intrinsic motivation; Crt.: creativity; CA: cognitive alternatives; CC: cognitive control



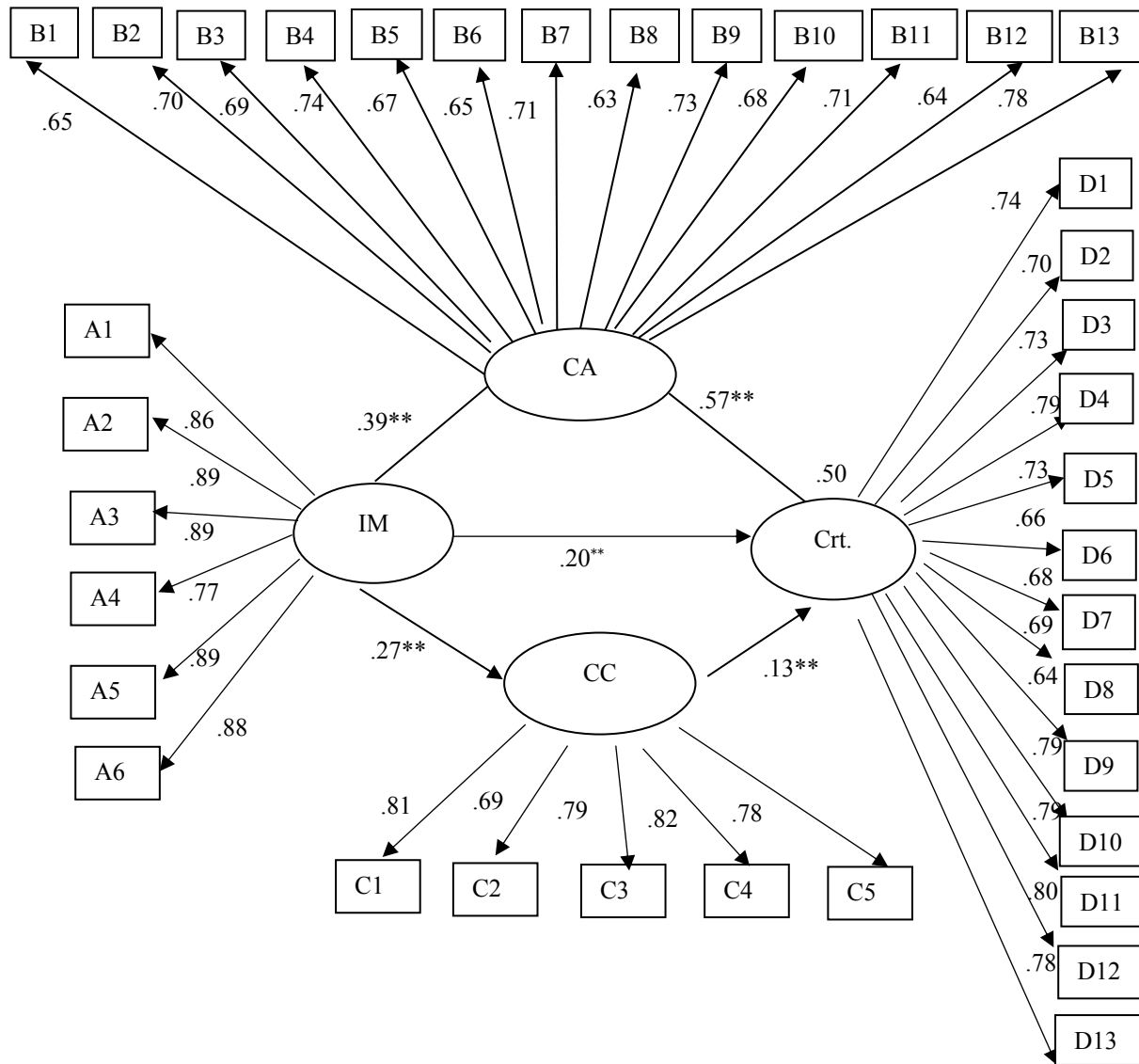


Figure 2. The SEM Full Model

Note. IM: intrinsic motivation; Crt.: creativity; CA: cognitive alternatives; CC: cognitive control

### Discussion

This research aimed to investigate how students' intrinsic motivation affects their creativity and how cognitive flexibility impacts the relationship between IM and creativity. The exciting findings obtained in the study are discussed below.

First, in this study, it was found that junior high school students' IM positively affects their creativity, which corresponds with the research of Deci and Ryan (1985) and that of Eisenberger and Shanock (2003), who verified the positive relationship between creativity and intrinsic motivation. People driven by intrinsic motivation primarily engage in an activity or perform a task due to interest, curiosity, eagerness, happiness, contentment, and the challenge of the activity itself (Amabile & Pillemer, 2012). Intrinsic motivation will propel them to devote their diligence to innovative tasks by enticing them to be pleasurable in their work and enjoy doing it (Amabile et al., 1996). According to Liu et al. (2016), intrinsic motivation can generate "an incentive force eager to do," arousing desire, passion, delight, and satisfaction in the task, thereby affecting creativity. It is confirmed throughout the literature that IM can significantly and positively predict students' creative performance (Gu et al., 2015). Cheng et al. (2021) particularly contend that intrinsic motivation has a positive effect on the creativity of gifted children.

Second, the positive effect of CF on junior high school students' creativity was revealed in this study. Cognitive flexibility has previously been shown to predict the successful performance of a variety of tasks, including creative ones (Heinze et al., 2009b; Jonassen, 2011; Vartanian, 2009). Similar to this finding, scholars of the field of creativity have proposed that creativity is affected by two pathways, namely, flexibility and persistence (Nijstad et al., 2010). The concept of "cognitive flexibility" was first proposed by Spiro et al. (1988), and in their study, CF was defined as a



person's ability to instinctively reframe his/her knowledge in different ways to adjust to altering situational needs. Barbey et al. (2013) define it as the interreact of multivariate mechanisms to respond to all kinds of demands. CF is the ability to achieve creative insights, solve problems, or generate ideas through extensive and comprehensive cognition categories. The more flexible individuals can flexibly switch among multiple categories, approaches, and sets, and they can also activate and use remote associations rather than close ones (Eysenck, 1993). According to Nijstad et al. (2010), CF is reflected using multiple categories and continual shifting among them. It is widely believed that CF is essential for creativity (Beghetto & Kaufman, 2007; Carson et al., 2005; Nijstad et al., 2010) and the solving of problems (Kloo et al., 2010).

Cognitive flexibility was examined in this study by dividing it into alternative and control dimensions and the results supported the positive effect of these sub-factors on junior high school students' creativity. Cognitive alternatives are generally defined as individuals' capability to identify alternative explanations for changing environmental needs and develop multiple solutions, while cognitive control indicates one's ability to perceive challenging circumstances as being controllable. Scholars have often associated creativity with the reframing of connections among distant ideas (Simonton, 1999) and with "breaking sets" or overcoming "functional fixedness" (Smith & Blankenship, 1991), and the factors noted above represent alternative attributes of cognitive flexibility. Cognitive control appears to be capable of assessing more self-efficacy-based beliefs (Johnco et al., 2014) and emphasizes individuals' confidence to cope with difficult situations. Based on the cognitive assessment theory, people will have positive emotions when they think the threats or challenges are controllable and they have the ability and means to deal with them (Lazarus, 2006). Fredrickson (2013) suggests that positive emotions contribute to creativity.

Third, the study finding verified that CF plays a partial mediation role between IM and junior high school students' creativity. Since no previous studies have overlapped with this one, the findings are expected to contribute to the relevant field. Cognitive flexibility, defined as the ability to restructure new substitutable plan in response to changing environment, has been related with personality traits (Compton, 2000). For example, the association between cognitive flexibility and intrinsic motivation has been explored by previous researchers (Li et al., 2018; Ryan & Deci, 2000c), who have found that IM has a powerful cognition dimension associated with people's perception that their ability makes themselves to perform well in the surrounding environment. According to the information processing theory of motivation, the cognitive process is shaped by personal desire and people is inclined to selectively comprehend, coding and retain information that is consistent with their desire (Nickerson, 1998). Therefore, people's desire to explore challenging situations will be ignited by their strong intrinsic motivation (Ryan, & Deci, 2000c). De Dreu et al. (2011b) discovered a positive relationship between behavioral activation and cognitive flexibility, and Deci and Ryan (2001) found a positive correlation between IM and students' CF.

Finally, not only did this study prove that IM and CF have a positive influence on junior high school students' creativity, but it went a step further to assess the mediation role played by CF on the relationship between creativity and intrinsic motivation. The mediating effect of the alternative and control sub-dimensions of cognitive flexibility between these variables was also demonstrated and compared. Lin et al. (2014) investigated the mediating role of CF between students' emotion and their creativity and found that CF had a positive effect on increasing students' creativity. The dual-pathway creativity model implies that personality traits or emotional states that increase cognitive flexibility can potentially arouse students' creativity via a flexible pathway (De Dreu et al., 2008). In this context, it is likely that middle school students who have intrinsic motivation as a personality trait may enhance their creativity by improving their cognitive flexibility. According to Shao et al. (2018), flexible processing plays an essential role between a motivational approach and creativity, and Baas et al. (2011a) observe that the motivational approach generally boosts creativity because it is associated with enhanced CF. Earlier researchers have highlighted the role of intrinsic motivation in creativity, but how and why IM is linked to creativity is fragmented in the existing literature. The motivation-cognitive model proposed in this study demonstrated the effect of IM on creativity via the alternatives and control sub-dimensions of cognitive flexibility and the mediating role of alternatives was found to be more significant than that of control.

### Conclusion

This study defined the individual traits like IM and CF affecting their creativity and investigated the participants' demographic characteristics and the extent of these variables. The study results showed that IM and CF positively impact students' creativity and the effect of IM on creativity is mediated partially by cognitive alternative and sub-dimension of flexible cognitive control. It can be seen in the study that cognitive alternative has a more significant mediating role than cognitive control.

### Recommendations

The effect of IM and CF on creativity was investigated in this study and it was found that these two elements can significantly promote the creativity of junior high school students in China. According to the research results, teachers and parents should firstly stimulate middle-school students' intrinsic motivation to learn in order to arouse their creativity. The self-determination theory (Deci & Ryan, 2000a) shows that intrinsic motivation can be enhanced by meeting basic needs, such as autonomy, competence and relationships. In this context, teachers should support

students' autonomy to meet their self-determination need and enable them to form a good relationship with their classmates. They should simultaneously provide students with more opportunities to actively participate in class to enable them to enjoy successfully accumulating experience, which will increase their self-confidence and self-belief.

It was also discovered from the research that CF plays a partial mediating role between junior high school students' intrinsic motivation and their creativity. The findings hinted that intrinsic motivation, partly mediated by the alternative sub-dimension of cognitive flexibility, has a more indirect effect on creativity than the control sub-dimension. The value of this finding in practice lies in the fact that the key to the positive effect of intrinsic motivation on creativity is to improve the cognitive flexibility via alternatives. Individuals use cognitive alternatives to identify alternative explanations in problematic situations and generate multiple solutions. People with more cognitive alternatives can restructure their knowledge rapidly and, hence, adapt their responses to meet radically-changing situational demands.

In contrast, Zabelina and Ganis (2018) examined the role of cognitive control in creativity and found that real-life creativity is not linked to cognitive control. Therefore, the estimation of creativity in this study using a self-reporting method may have produced different results from real-life creativity. Future researchers need to be more meticulous in examining the role of cognitive control in creativity in different fields and attempt to conduct an experiment to measure creativity.

### Limitations

This is a cross-sectional study and, although these have been widely used in current education and creativity research, a longitudinal study may be more helpful in obtaining new findings. Although the researcher considered that psychological factors such as motivation and creativity may change over time, this research had a time limit, being part of the doctoral program in Educational Administration. However, the use of a cross-sectional study design has laid a good foundation for further developments of this subject in future, and the results have identified the factors that have a positive and significant influence on cultivating students' creativity.

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### Authorship Contribution Statement

Wang: Conceptualization, design, data acquisition, data analysis/ interpretation, writing. Chang: Editing/reviewing, final approval.

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