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The Moderating Effect of Grit
on the Relationship Between Critical Thinking
and Creativity

Abstract

This study aims to examine the relationship among critical thinking, grit, and creativity, which will be core competencies in a future society, and to verify the moderating effect of grit as an individual psychological factor between the two variables. For this purpose, a Likert survey is conducted on undergraduate students in a Korean university; and 129 responses are used. The result shows that, first, critical thinking and grit have significant influences on creativity. Second, the moderating effect of grit on the relationship between critical thinking and creativity is significant. The finding indicates that the higher the grit, the higher the positive relationship between critical thinking and creativity. This result implies that to increase the creativity of college students, an education that increases both critical thinking and grit is necessary.

Key words: *grit, critical thinking, creativity, moderating effect*

Introduction

Among the principal competencies that will be required in a rapidly changing future society, creativity, which is the ability to come up with ideas that can create new knowledge and values, is considered a key competency (Plucker et al, 2020; Simonton, 2018). Creativity is also key in enhancing psychological well-being (Androshchuk et al, 2020). Therefore, creativity has been proposed as an important goal in university education (NEA, 2012; Rosba et al., 2021). However, research

on ways to promote creativity in a university environment is qualitatively and quantitatively insufficient (Karwowski, 2021; Swanzy-Impraim et al., 2022). It is especially necessary to find the cognitive and affective processes that influence the promotion of creativity (Eggers et al, 2017).

Many researchers see critical thinking as a key factor in creativity (Eggers et al., 2017). Critical thinking is proposed as the core competency of the 21st century and includes the entire process of systematically thinking and inferring given knowledge and information and the high-level cognitive ability to finally solve a problem (Kim & Seo, 2019). Prior studies have shown that critical thinking positively impact creativity (Fatmawati et al., 2019; Mohammadi et al, 2016; Rosba, et al., 2021). Therefore, creative problem-solvers have flexible and sharp critical thinking skills.

However, the magnitude of the effect of critical thinking on creativity varies from study to study. Some studies have reported a large or moderate effect of critical thinking on creativity (e.g., Rosba et al., 2021; Joo & Jeong, 2020), whereas other studies have shown that the influence of critical thinking on creativity is not significant (e.g., Eggers et al., 2017; Allen, 2009). The conflicting results of previous studies imply that there are variables moderating the relationship between critical thinking and creativity. Researchers have suggested that creativity comprises cognitive characteristics, such as intelligence, and affective characteristics, such as motivation (Lim, 2017). Prior studies have insisted that internal motivation, challenging attempts, and patience under failure are affective characteristics that lead to differences in producing creative results (Rojas, 2015). Therefore, it is necessary to investigate the affective factors that moderate the relationship between critical thinking and creativity.

Recently, grit has attracted the most attention as an affective characteristic related to creativity (Meerhaeghe & Dolins, 2017). Grit refers to the affective characteristics of an individual who, to achieve a goal, shows passion and patience over a long time (Duckworth et al., 2007). Grit is an important variable that predicts not only academic achievement but also performance in professional areas because it is a force that encourages a person to strive steadily despite failures and difficulties (Duckworth et al., 2011; Eskreis-Winkler et al., 2014). In particular, persistence and passion, which are sub-factors of grit, have been extensively dealt with in creativity research. The affective characteristics of overcoming uncertainty and exerting effort and patience in the face of difficulties are necessary for creative thinking (Reed & Jeremiah, 2017). Therefore, many studies have paid attention to grit as a major affective factor leading to creative performance (Kim et al, 2020; Meerhaeghe & Dolins, 2017).

Researchers have found that grit influences a dependent variable through a complex relationship with various variables. You (2019) reported that the interaction between critical thinking and grit significantly influences entrepreneurship. Shin & Oh (2020) demonstrated the moderating effect of grit in the relationship between coaching leadership and creative behavior. Kim et al. (2020) showed the mediating effect of grit in the relationship between personality and creativity. These results imply that grit might have a moderating role in the relationship between critical thinking and creativity.

In summary, previous studies have suggested that creativity is influenced by critical thinking and grit. However, prior studies only analysed the effect of each variable on creativity. Few studies have synthetically analysed the relationship between the predictors of creativity and investigated the complex mechanism of creativity.

Research Problem

This study aims to investigate the impact of critical thinking and grit on creativity and the moderating effect of grit in the relationship between critical thinking and creativity.

The research problems are as follows: (a) Do critical thinking and grit significantly affect creativity? (b) Is a moderating effect of grit in the relationship between critical thinking and creativity significant?

Literature Review

Creativity is the ability to think of new ideas to solve problems and to perceive unexpected and unrelated elements (Duff et al., 2013). According to PISA (Program for International Student Assessment), creative thinking has various characteristics and processes. First of all, the ability to think flexibly in various areas is required, and long-term efforts are needed to improve and develop ideas based on generating ideas (OECD, 2019). Creativity also requires integrated and divergent thinking that generates various ideas (Gnevek et al., 2018). In other words, creativity consists of devising original methods and solving problems by combining various knowledge and information.

Critical thinking includes high-level thinking skills beyond decision-making, problem-solving, and organising and evaluating arguments (Watson & Glaser, 1980). Since both critical thinking and creative thinking require logic-based

problem-solving, the central aspect of critical thinking reinforces creativity (Scott et al, 2004). Whenten and Cameron (2011) said that creativity is an extension of problem-solving and critical thinking, and McMullan and Kenworthy (2015) argued that critical thinking and creativity, must be combined to improve corporate performance. In other words, core critical thinking skills are required to develop creativity.

Recently, the aspect of grit as an individual's affective factor in relation to creativity has attracted attention. Grit is an enduring passion for achieving a goal (Duckworth & Gross, 2014). Therefore, grit is a psychological strength, which means the power to achieve long-term goals without giving up. In particular, persistence and passion, which are elements of grit, have been mentioned several times in research on creative thinking skills; and the affective characteristics of overcoming uncertainty and having effort and patience in the face of difficulties are necessary for creative thinking (Sternberg, 2012; Reed & Jeremiah, 2017). According to previous studies, people with high grit try to think creatively (Lim, 2017; Thaler & Koval, 2015). In other words, creativity requires reorganizing ideas for a long time to achieve results, which demands patience and effort (Rojas & Usher, 2012). Therefore, grit is a significant variable in predicting creative tendencies. In particular, grit has been reported to be a variable that has a positive moderating effect on performing in academic and professional fields (Han, 2021; Kim, 2021; Ma et al, 2020; Moles et al, 2017). Studies exploring the mediating effect of grit on creativity have shown that grit positively mediates personality and creativity (Kim et al., 2020).

Research Methodology

Research Sample

The participants of the study were 129 undergraduates from a university in Korea. Only college students who agreed to participate in the research were used as a sample in this research. There were 44 men (34.1%) and 85 women (65.9%). First-year students were 16 (12.4%), sophomores were 29 (22.5%), juniors were 53 (41.1%), and seniors were 31 (24.0%). The participants represent a wide range of academic majors.

Instrument

In order to assess the critical thinking and creativity of college students, this study used the "Core Competency Test for College Students" (Kim et al., 2018). Among the 5 competencies that the measurement is made up of, we used critical thinking (9 items, α = .79, e.g., "I use grounded information when analysing data") and creativity (9 items, α = .79, e.g., "I suggest new and useful ideas or solutions"). To measure the grit of college students, this study used Grit-S, which was created by Duckworth and Quinn (2009) by reducing the original grit scale (Grit-O) (8 items, α = .82, e.g., "I try constantly"). A 5-point Likert-type scale (5 = *very true*; 1 = *not at all true*) was used as the response format for all items.

Procedures

The survey was conducted in 2019. The participants in the study were well informed about the study in advance. The participants received an explanation of their right not to participate in the study without any penalty. A link to the questionnaire was advertised to the students who gave their informed consent. The questionnaire took approximately 10 minutes to complete. Strict confidentiality was maintained.

Data Analysis

All statistical analyses were conducted using the Statistical Package for the Social Sciences (IBM, New York, USA). Moreover, Pearson correlation coefficients and descriptive statistics for variables were analysed. Next, multiple regression was conducted to examine the influence of critical thinking and grit on creativity. The PROCESS computation macro described by Hayes (2012) was used to examine the moderating effect of grit on the relationship between critical thinking and creativity. A 95% bootstrap resampling procedure (5000 samples) was used in this analysis. This method calculates the conditional effect of critical thinking on creativity at different values (-1 standard deviation (SD), mean, and +1 SD) of the moderator, grit. The significance threshold was set at .05.

Results of Research

The descriptive information of each variable was presented (see Table 1). Variables were positively correlated to each other (all correlations were significant at $p < .001$).

Table 1. Descriptive statistics for variables

Variables	1	2	3	M	SD
1. Critical thinking	-			3.943	.485
2. Creativity	.796***	-		3.822	.485
3. Grit	.424***	.434***	-	3.189	.575

***$p<.001$

Multiple regression was used to explore the influence of critical thinking and grit on creativity. As presented in Table 2, results show that critical thinking and grit account for a significant amount of creativity variance ($R^2 = .64$, $F = 114.69$, and $p < .001$). Both critical thinking ($\beta = .75$, $t = 12.75$, and $p < .001$) and grit ($\beta = .12$, $t = 1.99$, and $p < .05$) are significant predictors of creativity.

Table 2. Regression analysis for variables predicting creativity.

	B	SE	β	t	F	ΔR²
Critical thinking	.746	.058	.747	12.750***	114.685***	.64
Grit	.098	.049	.117	1.991*		

The moderating effect of grit on the association between critical thinking and creativity was examined. As presented in Table 3, the finding indicates that creativity is significantly influenced by grit (B = -.92, t = -2.37, and $p < .05$) and the interaction between critical thinking and grit (B = .25, t = 2.64, and $p < .01$), but not critical thinking (B = -.06, t=-.19, and $p > .05$). The overall regression was statistically significant with 66% of the variance in creativity being explained (F = 82.42 and $p < .001$). The interaction term accounted for 2% of the incremental variance in creativity.

**Table 3.** Moderation analysis for variables predicting creativity

	B	SE	t	LLCI	ULCI	F	Total R²	ΔR²
Critical thinking	-.059	.310	-.190	-.671	.554		.66	
Grit	-.919	.388	-2.370*	-1.686	-.152	82.42***		
Critical thinking x Grit	.253	.096	2.644**	.064	.442			.02

*$p<.05$, **$p<.01$, ***$p<.001$

The analysis also showed that the effect of critical thinking on creativity was significant at the low level (-1 SD), middle level (Mean), and high level (+1 SD) of grit (see Table 4). Evidence for the moderating effect of grit is also provided visually in Figure 1. The graphic representation of the interaction between critical thinking and grit shows that the higher the level of grit is, the steeper the slope of the positive relationship between critical thinking and creativity becomes.

Table 4. Moderation analysis depending on conditional values of grit

grit	Effect	S.E	t	95% bias-corrected CI	
				LLCI	ULCI
Mean -1SD	.599	.080	7.500***	.441	.756
Mean	.731	.057	12.735***	.618	.845
Mean+1SD	.889	.079	11.288***	.733	1.045
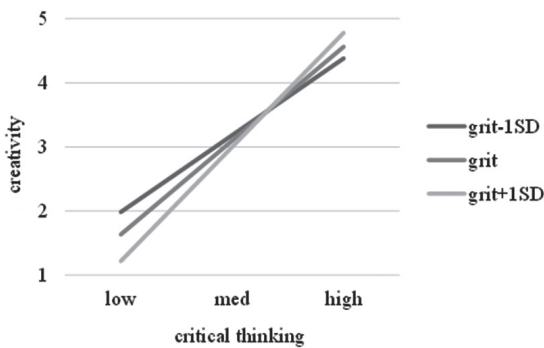
Figure 1. The moderating effect of grit

Discussion

This study examined the influence of critical thinking and grit on creativity and the moderating effect of grit on the relationship between critical thinking and creativity. The significant findings are described below.

First, critical thinking and grit positively affect creativity. The findings indicate that logical and critical, and divergent thinking, which has previously been emphasised in relation to creativity, is important in enhancing creativity. The findings also show that students with high persistence and passion can demon-

strate high competencies in creativity. It is consistent with previous studies, which have revealed that critical thinking and grit positively effect creativity (Eggers et al., 2017; Lim, 2017; Thaler & Koval, 2015; Seo, 2012; Yi, 2013). These results suggest that college students' creativity-enhancing programmes require training that reinforces logical and convergent thinking skills and affective factors such as persistence and willingness.

Second, the results point to grit as a significant moderator of the relationship between critical thinking and creativity. It confirms the hypothesis that there is a moderator of the relationship between critical thinking and creativity. This finding is in line with previous studies that have shown students' persistence and efforts have a positive moderating effect on academic and professional achievement (Han, 2021; Kim, 2021; Ma & Lan, 2020; Moles et al., 2017). The finding also supports the outcome that grit is a major mediating factor in enhancing creativity (Kim et al., 2020).

The statistically significant interaction between critical thinking and grit indicates that the positive relationship between critical thinking and creativity is strong at high levels of grit. In other words, the higher the grit, the stronger the relationship between critical thinking and creativity becomes. It also means that even if critical thinking is high, if there is a lack of personal patience, the effect of critical thinking on creativity might not be fully applied.

Moreover, this boosting effect of grit is strong when individuals manifest high levels of critical thinking. The result shows that high creative competencies can be achieved only when persistence to overcome difficulties is strengthened along with improving in critical thinking. It is difficult to expect high creativity if only one variable is high. Therefore, the result suggests that creativity would be maximised only when students' efforts, persistence, and power to overcome failure are in harmony with high cognitive competence.

This study has value as empirical research in designing creativity-enhancement education for college students by verifying the relationship that cognitive and affective factors have on creativity. Despite its interesting findings, this research has some limitations. First, the number of participants in the investigation was insufficient. Moreover, the subjects of the inquiry were limited to Korean students. Therefore, the findings might not be representative of college students worldwide. The second limitation is that the evaluation used a self-reported questionnaire to measure critical thinking, grit, and creativity. It would be worthwhile to examine the variables through objective observation.

Conclusion

Based on the results of this study, it was confirmed that both critical thinking and grit are required to promote creativity. Grit moderates the relationship between critical thinking and creativity. When the level of grit is elevated among individuals with high critical problem-solving abilities, outstanding creativity can be expected. In other words, a lack of grit lowers the effect of critical thinking on creativity. Therefore, it is necessary to develop a creativity-enhancing programme that strengthens logical thinking skills and improves students' persistence and passion.

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