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Self-Regulation in Creative Learning: Agentic Perspective

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ABSTRACT

Creativity is agentic, and so is learning. People create and learn new things most effectively when they are convinced that they can respond appropriately to the task (creative confidence) and value the activity at hand. This investigation explores the role of the relatively understudied aspect of creative agency: self-regulatory strategies. In a longitudinal study, we tested whether self-regulation strategies, previously found to be essential drivers of academic achievement and learning in general (rehearsal, elaboration, critical thinking, and metacognition), might also support creativity in learning. Specifically, we tested sequential mediation, where creative confidence and self-regulation longitudinally mediated the relationship between creative potential (divergent thinking) and effective application of creative skills to solve problems embedded in school subjects. Our findings confirm that self-regulatory strategies predict providing creative solutions to school tasks (a proxy of creative learning) and mediate the relationship between divergent thinking, creative confidence, and creative learning.

KEYWORDS:

self-regulation; creative learning; creative thinking; higher order strategies

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Thinking creatively is often mentioned as imperative for future learners. Indeed, to function effectively in the complex and ambiguous world, people need to flexibly change how they think and act. Yet finding solutions for today's problems also requires being an active and responsible learner: a skilled agent ready not only to acquire existing knowledge but also to transform it and generate new possibilities (Glăveanu, 2021). To this end, an array of various skills is needed. Cognitive and metacognitive skills play a particular role among them, as they inform the effectiveness of learning processes (Schunk & Zimmerman, 2011). However, the exact mechanisms such skills play in the process of creative learning are understudied. Here, we explore how cognitive and metacognitive skills, primarily self-regulation, contribute to creativity in learning.

ON INTERDIFFUSION OF CREATIVITY AND LEARNING

Creativity is ingrained in the learning process (Beghetto, 2016). When people learn, they often face problems that are novel to them. To solve such problems, new ideas and initial solutions are proposed and tested. This process is often embedded in randomness that might result in gathering new knowledge (Sweller, 2011, 2020). Sometimes, problem-solving gives insights—small acts of building personally meaningful knowledge and comprehension (Beghetto & Kaufman, 2007). This is one of the cases when creative processes and learning act intersect.

Yet, the multifaceted nature of creativity not only makes its links with learning quite complex, but also qualified by the specific understanding of creativity. While creativity is usually defined as the activity that brings new and valuable ideas or products (Runco & Jaeger, 2012), in educational settings, researchers are often interested in what Kaufman and Beghetto (2009) called mini-c and little-c creativity. Mini-c denotes mental processes that allow one to solve problems and take a flexible approach while performing different tasks, including school tasks. Little-c creativity is closer to hobby-like creative activities typical for adolescents (Zielińska, 2020). This is not to say that more superior levels of creativity—Pro-c and Big-C (Kaufman & Beghetto, 2009)—do not play any role in learning. However, in this article, we intentionally focus on two lower levels of creativity. We associate mini-c creativity with creative potential (Runco, 2004) as operationalized by divergent thinking (Runco & Acar, 2012). A factor that—in our investigation—largely resembles both mini-c and little-c is operationalized as "creativity in school achievement test" and reflects an ability to think and act creatively while solving school-related problems.

Considering creativity and learning from integrative perspective seems to be justified conceptually (Beghetto, 2021; Beghetto & Karwowski, 2019). Both creativity and learning are fueled by change—a new and relevant alteration in thoughts, feelings, and actions. Both can also be considered as processes of making changes and generating products—observable effects of introducing these changes. Researchers have found a modest yet significant relationship between creativity and academic achievement (Gajda et al., 2017). The latter is a salient outcome of learning. This article provides a slightly more dynamic test of the links between creative potential

and creativity as engaged in learning. More specifically, in a longitudinal study, we examine how creative potential (divergent thinking) predicts expressing creativity while solving tasks relevant to school subjects. This might—among others—involve finding a new way to obtain calculus results or imagining unknown consequences of the text being read during a language class. We apply a newly developed Creative Learning in School Achievement Test (CLISAT; see Karwowski et al., 2020, for more details) to investigate the effect of creative potential on the effectiveness of solving quite typical closed-ended tasks, as well as open-ended problems that are more likely to engage creative thinking and imagery. Furthermore, we test some predictions inspired by the Creative Behavior as an Agentic Action model (CBAA, Karwowski & Beghetto, 2019). More specifically, we examine whether creative confidence and self-regulation mediate the relationship between creative potential and the effects of learning.

ON THE DECISION TO PUT CREATIVITY INTO LEARNING

Although mutual interdependency of creativity and learning is quite widely accepted (Beghetto & Kaufman, 2010; Craft et al., 2001; Karwowski et al., 2020), there is still a need to expand our understanding of the nature of this link and factors that might strengthen or weaken its magnitude. For example, the vital force that drives both creativity and learning is composed of a broad range of self-beliefs, including self-efficacy or mindsets (Karwowski et al., 2019). Indeed, creative self-beliefs may qualify the effectiveness of learning new things and creating new knowledge. As the CBAA model (Karwowski & Beghetto, 2019) theorizes, a person who performs creative activity has a better chance for success when two factors are in place. The first is creative confidence: a conviction that one can appropriately respond to the task at hand. The second is valuing the undertaken activity. Altogether, these two factors play an intermediary (mediating and moderating) role in people's decision to behave creatively.

Yet even though creative self-beliefs often determine whether a person will or will not engage in creative activity, they relatively weakly explain the differences in actual creative performance (e.g., Haase et al., 2018; Pretz & McCollum, 2014). In short, being confident in one's creative abilities and perceiving the task as valuable is not enough to achieve creative success or—from a creative learning perspective—to gather new knowledge while solving novel problems. Hence, which factors are involved in transforming creative potential into creative action and achievement is still an open question.

SELF-REGULATION AS A SCAFFOLDING FOR CREATIVE LEARNING

As recently highlighted (Zielińska & Karwowski, 2021), the essential yet relatively understudied aspect of creative agency is self-regulation: a broad family of psychological processes through

which people shape their thoughts, emotions, and ways of action (Hofmann et al., 2012). By complementing the motivational force stemming from creative self-beliefs with more practical tools, self-regulation can make a creative success not only longed-for, but actually reachable. Thus, it serves as a crucial factor on the road from creative potential to creative behavior expressed in learning. Yet, while different self-regulatory skills and strategies have been found essential for learning (e.g., Boekaerts & Cascallar, 2006; Schunk & Zimmerman, 2013; Weinstein et al., 2011), their role in creativity is still largely unexplored.

One possible explanation for this gap arises from the fact that creativity used to be strongly associated with spontaneous, uncontrolled, and intuitive processes (Glăveanu, 2010; Sawyer, 2012). Indeed, serendipity (Darbellay et al., 2014), wonder (Glăveanu, 2019), and mind-wandering (Baird et al., 2012; Christoff et al., 2016) constitute an integral part of the creative process. But this is just a part of the equation. The missing piece is how people manage and regulate creative activity to complete this action and acquire new knowledge. The notion of such a 'more controllable' nature of creativity is not exactly a new idea. After all, creativity has been described as relying on generation but also selection (Bink & Marsh, 2000; Finke et al., 1992; Fürst et al., 2017), exploration but also exploitation (Steele et al., 2019), coexistence of associative and executive mechanisms (Silvia, 2018) or synergy of bottom-up and top-down processes (Benedek & Jauk, 2018). All these conceptualizations suggest that creativity represents an interaction of spontaneity and control, which also has been confirmed by a growing body of neuroscientific works (e.g., Beaty & Jung, 2018; Benedek et al., 2011). Creative processes do indeed seem largely controlled and built on top-down executive processes (Benedek & Jauk, 2018). Consider, for example, an executive re-interpretation of the well-established serial order effect, showing that ideas become more original with time (Beaty & Silvia, 2012). Often attributed to the classic spreading activation theory, this phenomenon was recently found to be highly controllable: it did not occur among more intelligent people who controlled their mental activity effectively. This is only one example of how people manage their thinking processes while solving creative tasks (see also Gilhooly et al., 2007; Jankowska et al., 2018). Thus, there are convincing arguments to posit that both the cognitive factors responsible for self-regulation (e.g., executive functions, intelligence) and the more personality-rooted self-regulatory strategies (see Inzlicht et al., 2021) cooperate and inform the processes of creativity and learning (Zielińska & Karwowski, 2021).

Indeed, studies show how applying self-regulation strategies predicts performance in different creativity tasks. For instance, Mawang and colleagues (2020) asked music students to carry out a creative composition task. Greater musical creativity of the compositions (rated by expert judges) was linked to adopting such self-regulatory strategies as organization, elaboration, and critical thinking. In another study (Jankowska et al., 2018), participants performed a drawing creativity test in eye-tracking glasses while concurrently providing spontaneous, think-aloud comments. Those who scored the highest in the test took a peculiar approach: not only did they explore many possibilities of solving it, but they also acted strategically by continuous control (planning, self-reporting, correcting, elaborating) of their work.

Interestingly, taking such a self-regulatory approach while engaging in creative activity can be effectively learned by observation. Students who watched videos showing how their peers cope with creative design task and simultaneously commented on this process (e.g., explained how they explore the task, deal with problems, try different solutions, select and combine ideas) provided more creative designs afterward in comparison with students who were simply instructed how to do this (Groenendijk et al., 2013).

The controllable aspects of both creativity and learning have been recently accentuated by researchers who take the perspective of self-regulated learning—one of the most prominent concepts in educational psychology (e.g., Panadero et al., 2017; Winne, 2018; Zimmerman, 2000)—to understand the creative process (Callan et al., 2019; Ivcevic & Nusbaum, 2017; Spoon et al., 2021; Zielińska et al., 2020). It was demonstrated that people use different ways to regulate their thoughts, emotions, and behavior while engaging in creative activity or performing a creative task. While preparing for such creative action, a person may benefit from planning, setting goals, and managing their own expectations about the creative process (e.g., anticipating the obstacles to overcome). During a creative task, effective self-regulation consists of attention focusing, managing emotions, and self-monitoring. Finally, after finishing the creative action, a person evaluates the obtained effects, makes causal attributions (e.g., assesses what the reason for poor performance was), and considers whether any room for improvement exists.

Importantly, such self-regulatory strategies are applied spontaneously by both students and teachers to support the learning process. A study on high-achieving middle school students demonstrated that those with above-average accomplishments in mathematics used critical and creative thinking as learning strategies more intensively than their lower-achieving peers (Liu et al., 2015). It was also found that professors in art and design schools focused on fostering their students' self-regulatory skills (e.g., setting and revising goals, monitoring, reflection) to enhance their creative performance (Greene et al., 2019).

Two self-regulatory components have been typically emphasized when it comes to school achievement and effectiveness of the learning process (e.g., Boekaerts, 1999; Pintrich, 2004; Pintrich & de Groot, 1990; Winne et al., 2002). The first refers to students' motivational beliefs, including self-efficacy, goal orientation, and personal value attributed to a learning task. Similarly as in the creative agency, students' motivational orientations adopted in the learning process allow them to become active learners, ready to decide whether or not to engage in a particular task (Pintrich & Garcia, 1993). The second component encompasses the means through which students can accomplish a task they have engaged in. Those are specific cognitive and metacognitive strategies of learning, such as rehearsal, knowledge organization, or attention monitoring, as well as ways of managing time resources and study environment.

While the role of different learning strategies has been systematically tested in various educational contexts, including increasingly used forms of distance learning (Neroni et al., 2019), there is scarcity of research on how the application of cognitive and metacognitive strategies translates into creativity in learning. The present study aims to fill this gap by examining the relationship between students'

creativity expressed in school tasks, their school performance, and the intensity of using higher-order, self-regulatory strategies. Moreover, we test the hypothesis that self-regulation, along with self-beliefs, mediates the association between creative potential and creative learning. Our conceptual model, driven mainly by the CBAA theorizing and the research we briefly overviewed, assumes a sequential mediation effect. As we illustrate in *Figure 1*, we expect creative potential to result in a higher level of creative confidence: a relationship that is very likely mediated by mastery experiences more creative people might have (see Bandura, 1997; Beghetto & Karwowski, 2017). Next, we hypothesize that creative confidence would make it more likely that a person will use a richer repertoire of self-regulatory strategies (Ivcevic & Nusbaum, 2017), which will allow to proceed more effectively with school-based tasks that require using creative processes to solve them.

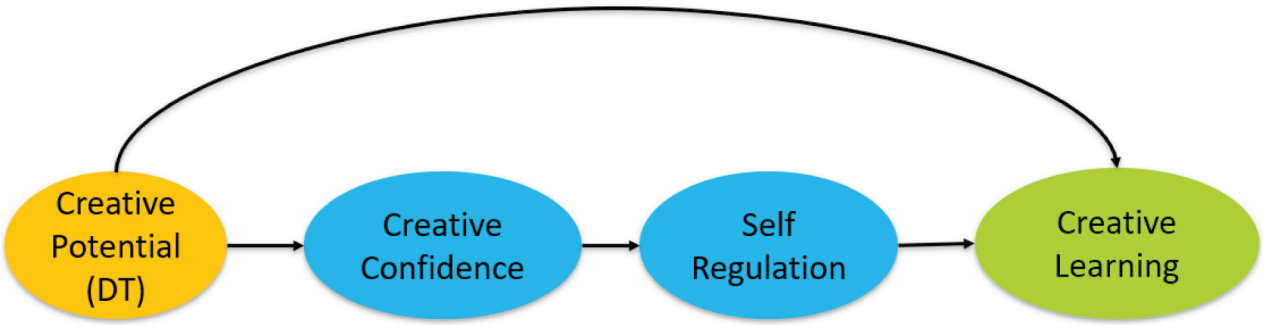


Figure 1. **A conceptual model tested in the study**

THE PRESENT STUDY

In this study, we examine the role of self-regulation for creativity. Specifically, our goal is to explore whether and how higher-order self-regulatory strategies, including rehearsal, elaboration, organization, critical thinking, and metacognition, predict creativity in school tasks. We also test a sequential mediation model inspired by the CBAA model (Karwowski & Beghetto, 2019), wherein creative confidence and self-regulation longitudinally mediate the relationship between creative potential (divergent thinking) and creativity in learning.

METHOD

Participants

Overall, 1,346 elementary (52%) and middle-school (48%) students (54% female) participated in a longitudinal study, with two waves (T1 and T2) nine months apart. The sample was nationwide; participants attended 60 schools. After recruiting schools, securing approvals from principals, and informed consent from parents and students, the study was conducted during regular class

hours. It took three 45-minute blocks to solve tests and fill all instruments we had provided the participants with.

Measures

T1 Measures

Divergent Thinking (DT). Three tasks were used to measure divergent thinking. The first was about providing unusual uses of toothpaste. The second, to come up with unusual consequences of a situation where there would be no cell phones or the Internet. The third, to list similarities between a chocolate bar and a computer. Responses to each of the tasks were scored for fluency (the number of ideas) and originality of all responses of the given respondent in each task (see Karwowski et al., 2020 for details). Two trained coders scored the tasks with appropriate reliability (ICC between .60 and .98, median ICC = .83).

Given that we were interested in the overall index of creative potential, we modeled a higher-order latent variable composed of latent variables of fluency and originality. We present intercorrelations between fluency and originality for each task in *Appendix Table A1*.

Creative Confidence. We used the Short Scale of Creative Self (Karwowski et al., 2018) to capture creative self-confidence. It was covered by six items (e.g., "I trust my creative abilities," α = .82). Participants used a 1-7 Likert scale, (*1 = definitely not*, *7 = definitely yes*).

T2 Measures

Self-Regulation. In T2, we applied the Polish version of Motivated Strategies for Learning Questionnaire (MSLQ; see Pintrich et al., 1991, 1993). MSLQ is composed of 37 items that relate to the typical ways participants use to manage their learning. Participants responded using *1 = definitely not* to *7 = definitely yes* Likert scale. As we were interested in higher-order self-regulation strategies (called cognitive and metacognitive strategies in MSLQ), we included the items that measured the strategies of rehearsal (3 items, e.g., "When I study for the class, I practice saying the material to myself over and over"), elaboration (5 items, e.g., "When reading for the class, I try to relate the material to what I already know"), organization (3 items, e.g., "I make simple charts, diagrams, or tables to help me organize course material"), critical thinking (5 items, e.g., "I often find myself questioning things I hear or read this course to decide if I find them convincing"), and metacognitive self-regulation (7 items, e.g. "If course materials are difficult to understand, I change the way I read the material"). Given that they correlated with each other substantially (rs between .44 and .68), we decided to model a latent factor of self-regulation loaded by these subscales. A high reliability of the manifest variable (α = .87), substantial factor loadings (see Figure 2), and results of confirmatory factor analysis (*CFI* = .98, *TLI* = .97, *RMSEA* = .092, *SRMR* = .022), supported the decision to rely on one factor.

Creativity and Learning in School Achievement Test (CLISAT). In the second wave, we used the Creativity and Learning in School Achievement Test (CLISAT) to measure creative processes engaged in solving language and math-related problems embedded in school-like tasks. A more detailed description of the CLISAT is provided elsewhere (Karwowski, 2020). In essence, CLISAT was

developed as a test that dynamizes the measurement of the links between creativity and learning. The CLISAT focuses on academic achievement and processes relevant for creative learning. It covers two broad domains: mathematics and the Polish language. Both domains follow the same format of blocks of tasks.

Initial blocks are composed of closed-ended tasks, similar to those typically used in school achievement tests. These tasks are followed by open-ended tasks, explicitly asking participants to think creatively and provide creative solutions to the questions posed. In the version of CLISAT used in this study (compare it to the version described in Karwowski et al., 2020), there were 28 tasks in total—14 in language and 14 in math. In both parts, ten tasks were closed-ended, and four tasks open-ended, measuring creativity-relevant processes. The open-ended tasks were scored for fluency (i.e., number of ideas generated), originality (i.e., rated uniqueness of response), or flexibility (i.e., number of different categories that a response could be assigned to). We modeled two latent factors—one referred to the closed-ended tasks and was composed of math and language manifest variables, and the other referred to creative processes and was composed of creativity subscores of language and math.

Procedure

This study was longitudinal with a nine-month-long gap between T1 and T2. Pragmatic reasons caused the length of the gap—we started the first wave of the study in late October (the semester starts in September), and therefore the second wave had to be conducted in early June to finish it before the school year ended (end of June). Both waves were conducted face-to-face in group settings in three classes (lessons). Informed consent was obtained from all students, their parents, and school principals.

Missing Data and Analysis Plan

Given the drop-out at the level of schools between T1 and T2, the effective sample size varied between $N = 840$ and $N = 1{,}346$. However, as missing data were missing completely at random, Little Missing Completely at Random (MCAR): $\chi^2(df = 22) = 33.55$, $p = .055$, we decided to rely on structural equation modeling using full information maximum likelihood estimation. Given the missing patterns, the effective sample size for our estimates was $N = 1{,}332$. To check for robustness of the findings, we also re-estimated our models with listwise deletion, with essentially the same results. All analyses were conducted in the lavaan package (Rosseel, 2012) for R (R Core Team, 2020).

RESULTS

Descriptive statistics and correlations between variables are provided in *Table 1.*, yet we emphasize that in our main set of analyses we utilized latent variables approach to control for measurement error. Although all correlations were statistically significant, they were mostly modest, except for the

robust links between divergent thinking in T1 and the results obtained in the CLISAT creativity scale in T2 ($r = .30$) as well as between the scores in the CLISAT creativity scale and CLISAT achievement scale ($r = .50$). Divergent thinking was also positively associated with creative confidence ($r = .11$), self-regulation ($r = .10$), and the CLISAT achievement scale ($r = .16$). Creative confidence was positively linked with self-regulation ($r = .14$), and results obtained in the CLISAT creativity scale ($r = .15$) and CLISAT achievement scale ($r = .16$). Self-regulation was positively related to the CLISAT creativity scale scores ($r = .19$).

***Table 1*. Descriptive Statistics and Correlations Between Study Variables**

Variables	1	2	3	4	5
DT (1)	(.77)	.11	.10	.30	.16
CC T1 (2)		(.82)	.14	.15	.16
SR T2 (3)			(.87)	.19	.03
CLISAT C T2 (4)				(.82)	.50
CLISAT A T2 (5)					(.80)
M	0	4.42	4.05	0	0
SD	1	1.13	0.96	1	1

Note. Values are correlations estimated using FIML estimator (N = 1,332). All correlations except SR T2-CLISAT A T2 are statistically significant. Cronbach's alphas are put in parentheses in the diagonal. DT = Divergent Thinking, CC T1 = Time 1 Creative Confidence, SR T2 = Time 2 Self-Regulation, CLISAT C T2 = Time 2 Creative Learning in School Achievement Test Results, creativity scale; CLISAT A T2 = Time 2 Creative Learning in School Achievement Test Results, achievement scale.

In the next step, we estimated a structural equation model with sequential mediation to examine whether participants' creative confidence and self-regulation mediate the links between DT in T1 and CLISAT creativity scores in T2. More specifically, we expected that higher divergent thinking would result in higher creative confidence (Karwowski & Beghetto, 2019) and that creative confidence in T1 will be positively associated with self-regulation in T2 (Zielińska & Karwowski, 2021). As illustrated in *Figure 2*, this pattern was indeed observed. Divergent thinking predicted creative confidence, and both creative confidence and self-regulation predicted time 2 CLISAT scores when creativity was considered. When we predicted the closed-ended part of CLISAT (i.e., academic achievement scale), the links with self-regulation disappeared and the direct effect of divergent thinking was substantially smaller ($\beta = .17$ compared to $\beta = .33$ in the case of links between divergent thinking and creativity part of the CLISAT). The model fit was good, with comparative fit index (*CFI*) = .97, Tucker Lewis Index (*TLI*) = .96, root mean square error of approximation (*RMSEA*) = .031, 90% *CI*: .027, .035 and standardized root mean square residual (*SRMR*) = .036. Importantly, the sequential indirect effect: divergent thinking – creative confidence – self-regulation – creativity score in CLISAT was statistically significant (see *Table 2*).

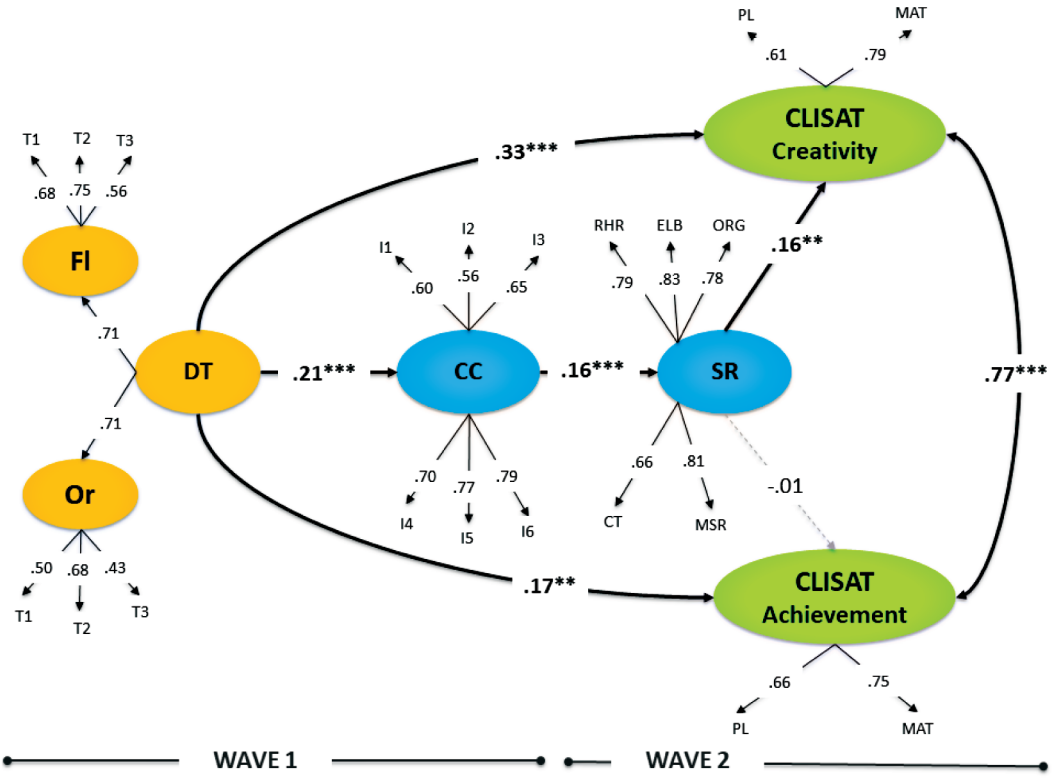


Figure 2. **A structural equation model testing the sequential mediation with creative confidence and self-regulation as mediators of the links between DT and CLISAT scores. Note: Cross-loadings between fluency and originality in subsequent tasks were omitted for readability. T1-T3 = Task 1-Task3; I1-I6 = Item1-Item6; PL = Polish language; MAT = Mathematics; RHR = rehearsal; ELB = elaboration; ORG = organization; CT = Critical Thinking; MSR = Metacognitive Self-Regulation. All values are standardized. **$p < .01$, ***$p < .001$.**

Table 2. **Indirect Effects and 95% Confidence Intervals**

Indirect Effect	Coefficient	95% BC CI
Overall Indirect	.043	.014, .072
DT – CC – CLISAT (Creativity)	.021	.000, .043
DT – SR – CLISAT (Creativity)	.015	-.001, .035
DT – CC – SR – CLISAT (Creativity)	.010	.001, .012

Note. Unstandardized indirect effects and 95% confidence intervals DT = Divergent Thinking, CC = Time 1 Creative Confidence, SR = Time 2 Self-Regulation, CLISAT = Time 2 Creative Learning in School Achievement Test Results (creativity scale).

DISCUSSION

Although students' creativity tends to be more pronounced outside of school than in the classroom (Runco et al., 2017; Zielińska, 2020), it is a vast overstatement to say there is no room for creativity in the school environment (Karwowski, in press). Quite the opposite, recent theories and research show how creativity and learning might go hand-in-hand (Beghetto & Kaufman, 2010; Craft et al., 2001; Sawyer, 2015), thus explaining the usually good academic performance of creative students (Gajda et al., 2017).

There is no creativity without a knowledge base that enhances the ability to distinguish conventional ideas from alternative and original ones (Glăveanu, 2021) and broadens the repertoire of potential steps one can use to solve a novel problem (Sweller, 2009). Still, however, the relationship between creativity and learning (to put it dynamically, see Beghetto, 2021) or school achievement (to take a more static approach, see Gajda et al., 2017) is far from straightforward. The complexity of this link is sometimes explained by the classroom's environmental characteristics that may support or dampen creativity (Beghetto & Kaufman, 2014; Davies et al., 2013; Richardson & Mishra, 2018). For example, teachers were criticized as having a biased perception of students' creativity (Kettler et al., 2018; Westby & Dawson, 1995) and being unable to recognize creative students (Gralewski & Karwowski, 2019; Ridgley et al., 2019; Hoff & Carlsson, 2011).

As theorized in the CBAA model (Karwowski & Beghetto, 2019), personal beliefs, namely creative confidence and valuing creativity, serve as critical factors that might shape the decision to *engage* (or *not engage*) in creative behavior. Similar components have been considered as influencing students' engagement in a learning process, including expectations about their own performance, a genuine interest in the task, and emotional reactions to this task (Pintrich & de Groot, 1990; Pintrich et al., 1993). However, although such beliefs have high motivational importance, they represent more of a *desire* or *willingness* to take a particular action than the *means* to actually enact any changes (Frazier et al., 2021). Hence, another factor that builds a sense of one's agency encompasses effective metacognitive and control strategies—allowing for finishing a task that one is motivated to accomplish.

Self-regulatory strategies have been extensively studied with regard to the learning process (e.g., Dignath & Büttner, 2008; McDaniel & Einstein, 2020; Schmitz & Wiese, 2006), showing that how students manage time resources and study environment predicts their academic performance (Schunk & Zimmerman, 2011). Given how motivational and cognitive components cooperate in building agency in learning, a question is to what extent a similar mechanism occurs in the case of a creative agency. In other words: do self-regulatory processes, along with motivational self-beliefs, participate in building creative agency?

In this study, we were particularly interested in the role of self-regulation—understood as a constellation of various psychological control processes (Malanchini et al., 2019)—in creativity, with a particular focus on creative learning. Specifically, we investigated the indirect yet plausible mechanism behind the transition of creative potential into creativity as expressed in school-like tasks. Expanding on the CBAA model's foundation, we hypothesized that self-beliefs (i.e., creative confidence) and self-regulation longitudinally mediate the relationship between students' creative potential and their creativity in learning.

Consistently with predictions, we observed a robust ($\beta = .33$) longitudinal link between students' divergent thinking—a well-established indicator of creative potential (Runco & Acar, 2012)—and their subsequent performance in the test devoted to measuring various creative-learning relevant processes (Karwowski et al., 2020). Importantly, the links between divergent thinking and closed-ended tasks resembling typical school achievement measures were not only lower ($\beta = .17$) but also consistent with the recent meta-analysis (Gajda et al., 2017, see also Karwowski, in press).

Our findings respond to the call for more integrative conceptualizations of creative learning (Beghetto, 2016; Ma & Van Oystaeyen, 2016; Rubenstein et al., 2018), which emphasize the mutually reinforcing relationship between creativity and learning. In particular, there is a need to raise awareness of how students' creativity may support their learning process and thus boost academic achievement (Gajda et al., 2017; Schacter et al., 2006). While we acknowledge that our approach was not dynamic enough to untangle many nuances associated with the relationship between creativity and learning, its longitudinal design allows us to formulate some potentially important conclusions.

Notably, in the present study, we proposed and tested one of the mechanisms that might underlie the relationship between creative potential understood as a person's trait and observed creativity in school tasks. We demonstrated that divergent thinking scores predicted creative confidence, which further predicted self-regulation. Both creative confidence and self-regulation were associated with creativity in solving language- and math-related problems, but not the effectiveness of solving typical school tasks. Furthermore, we observed the significant indirect effects showing that creative potential—by working through the chain of creative confidence and self-regulation—longitudinally associates with creative performance in school tasks.

The obtained pattern, wherein divergent thinking results in creative confidence and eventually in better creative performance in school tasks, is in accordance with the agentic perspective on creative action (Karwowski & Beghetto, 2019). In short, students' creative potential alone might not be sufficient to result in creative solutions to a creative learning task. Unless students perceive their creative abilities as well-aligned with a given problem, they will rather reluctantly use them in school tasks or, in fact, in any creative action. Engagement in learning strengthens creative confidence (Álvarez-Huerta et al., 2021), which helps to maintain the efforts while facing challenges and hurdles (Bandura, 1997; Karwowski & Lebuda, 2017) and enjoy the task more (Intasao & Hao, 2018). Consequently, the chances for more creative outcomes increase (Tierney & Farmer, 2002, 2011).

The role of motivational processes in boosting one's agency has already been demonstrated in the context of learning (e.g., Daumiller & Dresel, 2019; Engelschalk et al., 2017; Grunschel et al., 2016; Hulleman & Harackiewicz, 2009) and creativity (Beghetto, 2006; Haase et al., 2018; Hass et al., 2019; Karwowski & Barbot, 2016). Our study extends these findings by showing that students might use creative confidence to express creativity in school tasks more effectively. However, the crucial question is whether self-regulation does help students become creative learners?

Even if tentative, our results provide empirical evidence to answer this question positively. It turned out that higher creative potential predicted creative confidence and the usage of self-regulatory strategies, which then resulted in higher creativity in school tasks. Putatively, doing well in creativity tasks and at the same time being aware of it might work as a kind of a cue—similarly to the "be creative" instruction (Nusbaum et al., 2014)—that prompts people to apply self-regulation strategies. Furthermore, students who were more confident in their creative abilities were also more likely to engage in such executively controlled processes. This result is in line with past work,

showing that people with solid self-confidence adapt adequate cognitive and metacognitive strategies while learning (e.g., Dweck & Master, 2008; Zimmerman, 2011; Zimmerman et al., 1992).

Our study revealed that students who managed their learning through the various self-regulatory strategies (i.e., rehearsal, elaboration, critical thinking, and metacognitive control) performed better in creative school tasks, but—quite surprisingly—not in typical tasks often met in academic achievement tests. This effect can be seen as another demonstration of the controllable nature of creativity driven by executive processes. Indeed, people can exert control over the psychological processes involved in a creative action (Beaty et al., 2014; Benedek et al., 2014; Gilhooly et al., 2007; Zabelina et al., 2019). And those who more effectively self-regulate their thoughts and behaviors relevant for creativity are more likely to perform better in creativity tasks (Callan et al., 2019, 2021) and pursue more creative projects (Zielińska et al., 2020).

What needs to be highlighted as a unique contribution of this study is the longitudinal sequential mediation of creative confidence and self-regulation on the relationship between creative potential and creativity in school tasks. Thus, our results provide empirical evidence that supports and goes beyond the assertion made in the CBAA model. Indeed, having a creative potential is not sufficient to be creative in real life, whether it means for a student to enjoy the out-of-school creative activities or to perform creatively while at school (Agnoli et al., 2018). To learn new things, students need to be convinced of their ability to respond to the particular learning task appropriately. But what makes creative learning even more agentic is the involvement of self-regulation—a deliberate control over *how* a student actually learns and creates.

Limitations and Future Directions

The findings reported in this article should be interpreted in light of two limitations. First, to examine students' self-regulation, we used a questionnaire designed to measure typical rather than creative learning strategies. Thus, the strategies more specific for creative self-regulation could be not captured by this instrument. While future studies may benefit from applying better-tailored measures (see, e.g., Zielińska et al., 2020), we believe that the findings of this study have an additional explanation. Creativity and learning are mutually dependent (Beghetto, 2016; Beghetto & Karwowski, 2019): creativity influences learning, and academic learning and knowledge are beneficial for creative performance. This is precisely the direction shown in our study: strategies students typically use to manage their learning were conducive to creativity expressed in school tasks. How a person approaches a novel task is indeed determined by the existing knowledge (Kaufman & Beghetto, 2009; Simonton, 2000) but also by the way this knowledge is gathered, stored, structured, (re)organized, and transformed (Sweller, 2009, 2011).

Second, because we measured rather than experimentally manipulated our mediators, causal claims should be made cautiously. Although the longitudinal design of our study to some extent softens this limitation, we encourage fellow researchers to replicate our findings in experimental studies. We believe that future studies should investigate how to strengthen and support students' creative confidence and self-regulation. One promising approach is based on the so-called wise

interventions—brief yet effective ways to convince students that creative activity is fun and engaging and show them why, how, and when to be creative. Initial results using this approach provided quite positive effects (Zielińska et al., 2021). Such wise interventions might particularly benefit from the opportunities created by contemporary technology. Technological advances, including immersion in virtual reality (Agnoli et al., 2021; Toumi et al., 2021) or using social media (Fleith et al., 2021), when used wisely, might indeed form a way to support creative self-beliefs and creative self-regulation.

CONCLUSION

Both creativity and learning benefit from self-efficacy and effective self-regulatory strategies. This longitudinal investigation, drawing on the CBAA model, has shown that solving open-ended tasks that require creative thinking and are embedded in school subjects not only benefit from students' divergent thinking, but also their creative confidence and self-regulatory strategies. Although creative potential served as a significant predictor of creative functioning in school tasks, it was also associated with creative task results indirectly—thanks to strengthened creative confidence and more effective strategies. In sum, these findings provide the next step to understand better the conditions of putting creative potential to work.

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Appendix.

***Table A1*. Correlations between divergent thinking indices**

	2	3	4	5	6
T1F (1)	.25	.52	.16	.39	.13
T1O (2)		.19	.34	.14	.21
T2F (3)			.42	.42	.22
T2O (4)				.26	.32
T3F (5)					.45
T3O (6)					

Note. T1-T3 = Task 1 – Task 3; F = Fluency; O = Originality. All correlations are significant at $p < .01$

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