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Causal Relationship between Creativity-Oriented Intrinsic Motivation and Creative Achievements: Mediated by Mediation of Self-Actualization

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ABSTRACT

Objective: The present study aimed to test and compare the causal relationship between creativity-oriented intrinsic motivation and creative achievements with the mediation of self-actualization in male and female secondary school students of Yazd city.

Methods: The statistical encompassed all male and female second-grade students in Yazd city during the academic year 2023. Through the multi-stage random sampling technique, 340 individuals were chosen as the sample for hypothesis testing. Research variables were assessed using various questionnaires such as Creative achievement questionnaires (Carson et al., 2005), Dynamic mental attitude questionnaire (Karwowski et al., 2014), Creative effectiveness questionnaire (Karwowski et al., 2012), Creative intrinsic motivation scale (Taylor & Kaufman, 2021) and Ahvaz self-actualization questionnaire (IsmailKhani et al., 2010). Data analysis was conducted using the Structural Equation Modeling approach and AMOS software.

Results: The outcomes indicated that the proposed model fits well. The findings revealed that the indirect relationship between dynamic mental attitude, creative effectiveness, creative personal identity and creative inner motivation with creative writing, invention and scientific discovery through self-actualization is significant, with path coefficients ranging from β=0.14 to β=0.31, all statistically significant ($p < 0.001$). Moreover, the standard coefficients of the path between self-actualization and invention in this model for male students is β=0.15, while for girls it is β=0.08. Therefore, the difference of this path in the two groups is confirmed in favor of male students.

Conclusions: Overall, it can be concluded that motivation oriented towards creativity can enhance students' creative accomplishments through the mechanism of self-realization.

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Introduction

Creativity is a cognitive process involving the generation of novel ideas or concepts and the establishment of new connections among existing ideas, considering a scientific perspective. The generation of creative ideas is assessed based on their originality and appropriateness (Gibbons et al., 1994). Within the realm of creativity, distinct entities such as a creative individual, creative output, creative procedure, and creative setting exist independently (Kelley & Kelley, 2013) posit that individuals' drive directs their actions, shaping their beliefs about their capabilities, envisioning outcomes, setting objectives, and formulating strategies to attain those objectives. Creativity is commonly defined as a distinct and enduring attribute, separate from intelligence, that serves as a wellspring of innovation (Carson et al., 2005). Scholars studying creativity often analyze it through the lens of the "four p's": person, process, product, and press. Consequently, creativity can be understood as the interplay of talent, process, and surroundings through which an individual or group generates a meaningful output that is both unique and practical (Beghetto, 2006). Within this framework, motivation is arguably the most crucial component, acting as a driving force (Csikszentmihalyi et al., 2014). Only when an individual's motivation is activated can they channel their personal talents into the creative process, potentially yielding a creative output and its evolution (Hennessey, 2010). In the study of creativity, two fundamental approaches are employed: (1) focusing on motivation as distinct individual traits and (2) emphasizing the impact of environmental factors (Hennessey, 2010). The former approach typically examines the strengths of behavioral tendencies linked to creativity, such as individuals' inclination towards creative pursuits, while the latter aims to elucidate the underlying motivations driving specific tendencies (Hennessey, 2010).

From a socio-psychological standpoint, the primary motivators of creative behaviors can be categorized into internal and external motivations (Amabile, 1996). Intrinsic motivation refers to engaging in an activity for its inherent enjoyment and satisfaction, while extrinsic motivation involves participating in an activity for external incentives, such as recognition or rewards (Amabile, 1996).

Despite the plethora of measurement scales elucidating the driving force behind creative inclinations, the behaviors linked to creativity remain inadequately explicated. This lack of clarity is in part attributable to the broad nature of the concept and expression of creative behaviors, which

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allows for the accommodation of various actions. For instance, within the framework of personality theory, behaviors associated with the personality trait of openness encompass endeavors to engage in novel experiences (Kaufman et al., 2008). These specific creative behaviors typically have a limited timeframe. Indeed, the generation of creative output necessitates a heightened level of motivation. Nevertheless, assessing whether individuals exhibit high or low motivation towards creativity proves challenging in the absence of a detailed understanding of the behaviors tied to creativity. Consequently, the concept of creative motivation benefits from delineating the structure of behaviors associated with creativity, enabling the evaluation of the intensity of these behavioral tendencies in individuals (Amabile, 1996). Creative motivation, which integrates three distinct driving forces and behaviors related to creativity, can be conceptualized as an impetus propelling individuals to engage in activities characterized by innovation, accomplishment, and knowledge acquisition (Kozbelt et al., 2010).

The collection of creative outputs or productions generated throughout an individual's lifespan is denoted as creative achievement (Carson et al., 2005). The impact of creativity is pervasive, manifesting in a myriad of modern technologies, inventions, musical compositions, literary works, and more. Creative achievements are observable in the pursuits of individuals whose identity is deeply rooted in their creative endeavors. Creativity represents the culmination of creative expression; it involves the application of innovative thinking across various domains to yield fresh and original outcomes. Intrapersonal and interpersonal factors exert influence on creative achievements, with cognitive abilities (such as intelligence), personality traits (e.g., self-assurance, non-conformity), internal drive, and talent standing out among the intrapersonal factors.

According to the subjective intention theory, individuals hold diverse beliefs regarding the malleability of individual characteristics including intelligence, personality traits, morality, and even specific attributes like willpower, interests, or emotions (Tamir et al., 2007). Dweck (2006) delineated two distinct mindsets: those subscribing to the entity theory (or fixed mindset) view fundamental human characteristics as immutable and impervious to change, while those embracing the incremental theory (or growth mindset) perceive such traits as adaptable and capable of substantial development.

The advantage of dynamic mindsets over fixed mindsets is mainly attributed to the belief that one can always overcome obstacles and achieve goals with hard work (Dweck, 2006). As a result,

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people with dynamic mental orientations tend to adopt learning goals instead of performance goals, make more efforts to achieve goals, are more flexible and stable when facing obstacles, and are more resilient when faced with Failures show a more appropriate reaction (Bernecker et al., 2017). Sternberg (1999) by focusing on people's personal definition of each construct, found that people conceptually have different implicit theories about creativity and intelligence. However, a study by Plucker et al. (2010) showed that there is a significant overlap between implicit theories of intelligence and creativity.

In this context and regarding the constructs related to creativity, self-efficacy can be mentioned, which refers to people's beliefs about their abilities to perform a task successfully at certain levels (Bandura & Schunk, 1981). From Bandura's self-efficacy theory, the concept of creative self-efficacy was presented, which is defined as the belief in the ability to do creative work (Tierney & Farmer, 2002). Students who have high levels of creative efficacy have more positive beliefs about scientific abilities in specialized fields, which indicates that they are more likely to plan carefully in the scientific field than students with lower creative efficacy (Tierney & Farmer, 2002). Among the issues related to identity creativity, Was et al. (2009) believe that identity is a multidimensional structure and has different types that include ethnic identity, Occupational identity is social identity, academic identity and creative personal identity. Creative personal identity is the perception of creativity and a positive attitude towards it (Tierney & Farmer, 2002). which are related to creative abilities and are much more dynamic and flexible than fixed personal characteristics and are positively related to creative mindset and development (Plucker et al., 2010).

Researchers around the world use the concept of self-actualization. This term describes the state of full use of a person's abilities (Greene & Burke, 2007). The actions of self-actualized individuals are not solely determined by the physical and social environment. The reason for this is that such people have access to resources that are considered necessary to promote growth and development (Chang & Page, 1991). Self-actualization is a process in which a person must choose between growth and safety and between progress and regression (Chang & Page, 1991). In the process of self-actualization, people are able to acquire sufficient knowledge and information about their nature, attitudes, skills, and abilities, and this self-awareness also helps people identify limitations and make progress.

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In relation to the variables of this research, we can mention some researches that have been done in this field. The results of Álvarez-Huerta et al. (2022) showed that there is a positive relationship between student motivation and creative effectiveness with the mediation of self-actualization. E Cravens et al. (2020) showed in their research that the participants believed that holding creativity workshops would increase their productivity and creative confidence. Steele et al. (2017) showed in research that the external motivation to start an activity in the short term can play a role as an effective stimulus, but it is the internal motivation that can have a lasting impact on the way to reach the goal. In research Hennessey (2010) examined creative intrinsic motivation and self-actualization showed that intrinsic motivation has a positive relationship with self-actualization, but extrinsic motivation has a negative relationship with self-actualization. Karwowski et al. (2020) showed that dynamic mental attitude has a positive relationship with self-actualization, but constant mental attitude has a negative relationship with self-actualization. In research Mirzaei (2020) showed that between Gardner's multiple intelligences and creative achievements and personality dimensions and creative achievements have a significant positive relationship. Based on the results of this research, it is possible to predict creative abilities based on intelligence level and personality traits.

In this study, it is essential to consider that the exploration of an inclusive model investigating various factors impacting creative accomplishments stands as a fundamental concern within educational frameworks and can serve as a crucial and pragmatic approach to recognizing elements associated with creative achievements and offering effective solutions. In this investigation, a model illustrating the interrelation among research variables has been devised through an analysis of the research background. Despite previous studies revealing diverse connections among certain variables within this model among students, a comprehensive modeling study has not been conducted. Consequently, this study aims, initially, to evaluate the model holistically and subsequently, to assess the model's suitability for both male and female cohorts. Hence, the primary objective of this research is to assess and juxtapose the causal model of creativity-focused motivational inclination (comprising dynamic cognitive stance, creative efficacy, creative self-concept, and creative intrinsic drive) with creative accomplishments (encompassing creative writing, innovation, and scientific breakthroughs) while considering the mediating effect of self-actualization among male and female high school students of Yazd.

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Material and Methods

This investigation took the form of a correlational study (utilizing the path analysis technique) aimed at examining and contrasting the causal relationship between motivation geared towards creativity and actual creative accomplishments, with the mediating role of self-actualization. The statistical cohort for this study encompassed all male and female students at the high school schools in Yazd city during the academic period of 2023. Through the multi-stage random sampling approach, 200 individuals were chosen for the assessment of validity and reliability, while 340 participants were selected as the sample for hypothesis evaluation. Consequently, the current study computed a total of 33 parameters, considering the count of direct pathways (19 pathways), exogenous variables (4 variables), covariances (6 covariances), and error variances (4 errors). Ethical standards were strictly adhered to in this research, ensuring participant confidentiality and enabling them to complete the questionnaires anonymously and in a conducive setting. The assessment instruments employed in this study consisted of creative achievement questionnaires, a mental attitude survey, and a creative effectiveness questionnaire. The data was subjected to analysis using AMOS-21 software.

Instruments

Creative achievements questionnaire: The creative achievements questionnaire utilized in this research was established by Carson et al. (2005). Comprising 96 items, this questionnaire assesses 10 aspects including visual arts, music, dance, architectural design, sports teams, creative writing, invention, scientific discovery, film and theater, and culinary arts. Specifically, the current study focused on the creative writing, invention, and scientific discovery components, each comprising 8 items. Participants are required to indicate their achievements by marking the relevant items on a self-report checklist. Scoring ranges from 0 to 7, encompassing an option for "no achievement" worth zero points, up to "I have received professional training in this field."

In their study, Carson et al. (2005) reported the internal consistency of this questionnaire as 0.81 and 0.96, respectively, using retest methods and Cronbach's alpha. Conversely, Sangsuk and Siriparp (2015) indicated the internal consistency of the questionnaire as 0.69 and 0.71, respectively, through test-retest methods and Cronbach's alpha. Confirmatory factor analysis conducted in the present study revealed satisfactory model fit indices (Chi-square: 2.07), (IFI=0.89), (CFI=0.89), and (RMSEA=0.07), while the reliability coefficient for the creative

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achievement's questionnaire was determined as 0.87 for creative writing, 0.85 for invention, 0.84 for scientific discovery, and 0.93 for the overall questionnaire using Cronbach's alpha method. Furthermore, employing the halving method, the reliability coefficient for the creative achievement's questionnaire was computed as 0.84 for creative writing, 0.88 for invention, 0.79 for scientific discovery, and 0.86 for the complete questionnaire, signifying an acceptable level of reliability.

Dynamic mental attitude questionnaire: The questionnaire was developed by Karwowski et al. (2019). It consists of 10 items and responses are rated on a five-point Likert scale ranging from 1 (definitely no) to 5 (definitely yes). The score range for this questionnaire is 10 to 100. The reliability coefficient, as reported by Karwowski et al. (2019), using Cronbach's alpha method was 0.87. Moreover, confirmatory factor analysis was conducted in the present study, revealing results within an acceptable range for the assumed model (Chi-square: 1.72), (IFI=0.96), (CFI=0.96), and (RMSEA=0.06). The reliability coefficient for the dynamic mental attitude questionnaire was found to be 0.85 using Cronbach's alpha and 0.81 using the halving method.

Creative Effectiveness Questionnaire: This Questionnaire was developed by Karwowski et al. (2013). It comprises 11 items measuring creative effectiveness (6 items) and creative personal identity (5 items) on a five-point Likert scale from 1 (completely false) to 5 (completely correct). The reliability coefficients reported by Karwowski et al. (2013) using Cronbach's alpha were 0.87 for creative effectiveness and 0.85 for creative personal identity. Confirmatory factor analysis conducted in the current study showed results within an acceptable range for the assumed model (Chi-square: 1.47), (IFI=0.96), (CFI=0.96), and (RMSEA=0.05). The reliability coefficients obtained for the creative effectiveness questionnaire were 0.72 for creative effectiveness, 0.78 for creative personal identity, and 0.81 for the entire questionnaire using Cronbach's alpha. The reliability coefficients using the halving method were 0.72 for creative effectiveness, 0.78 for creative personal identity, and 0.63 for the entire questionnaire.

Creative internal motivation questionnaire: This Questionnaire was created by Taylor and Kaufman (2021). It consists of 20 items assessing internal creative motivation and external creative motivation using a five-point Likert scale from 1 (completely false) to 5 (completely true). In their study, Taylor and Kaufman (2021) reported reliability coefficients of 0.76 for internal creative motivation, 0.68 for external creative motivation, and 0.74 for the entire questionnaire using

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Cronbach's alpha. Confirmatory factor analysis in the current research indicated results within an acceptable range for the assumed model (Chi square: 1.79), (IFI=0.95), (CFI=0.95), and (RMSEA=0.06). The reliability coefficient for the internal creative motivation scale was determined as 0.86 using Cronbach's alpha and 0.85 using the halving method.

Ahvaz self-actualization questionnaire: The questionnaire utilized in this study was developed by Ismail Khani et al. (2010). Consisting of 25 items, responses were evaluated on a four-point Likert scale ranging from 0 (never) to 3 (most of the time). Ismail Khani et al. (2010) assessed the reliability of the questionnaire, yielding a test-retest coefficient of 0.90 and a Cronbach's alpha of 0.92. Mohammadi and Asghari Ibrahimabad (2020) further confirmed the reliability with a coefficient of 0.91, applying the Cronbach's alpha method on 75 couples involved in the study. The present investigation also conducted a confirmatory factor analysis, demonstrating satisfactory fit indices in the hypothesized model (Chi-square: 1.74), (IFI=0.82), (CFI=0.81), and (RMSEA=0.06). The self-actualization questionnaire exhibited a reliability coefficient of 0.87 via Cronbach's alpha and 0.85 through the halving method, affirming the questionnaire's reliability.

Results

Descriptive findings of research variables including mean, standard deviation, minimum and maximum score of variables is listed in Table 1.

Table 1. Descriptive findings of research variables

Variable	Mean	SD	Min.	Max.
Creative writing	29.99	12.44	9	55
Invention	29.19	12.74	9	55
Scientific discovery	29.12	12.77	9	55
Self-actualization	34.31	15.34	10	68
Dynamic mental state	23.53	10.40	10	50
Creative effectiveness	13.30	6.70	6	29
Creative personal identity	10.78	4.92	5	24
Intrinsic creative motivation	26.41	5.52	10	48

Table 2 shows the correlation coefficients between research variables.

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Table 2. Matrix of correlation coefficients between research variables

	Variable	1	2	3	4	5	6	7
1	Creative writing	-						
2	invention	0.45**	-					
3	Scientific discovery	0.46**	0.44**	-				
4	Self-actualization	0.46**	0.41**	0.44**	-			
5	Dynamic mental state	0.45**	0.40**	0.41**	0.43**	-		
6	Creative effectiveness	0.42**	0.40**	0.44**	0.37**	0.36**	-	
7	Creative personal identity	0.41**	0.48**	0.46**	0.35**	0.28**	0.32**	-
8	Intrinsic creative motivation	0.42**	0.42**	0.43**	0.40**	0.36**	0.28**	0.34**

**p < 0.01

As the results in Table 2 show, the highest correlation value between creative personal identity and invention (r=0.48, p<0.01), and the lowest correlation value between creative personal identity and self-actualization (r = 0.35, p<0.01).

Table 3. The fit indices of the proposed model and the modified model

Indices	χ^2	DF	χ^2/DF	GFI	AGFI	NFI	CFI	IFI	TLI	RMSEA
Proposed model	10.45	3	3.48	0.99	0.90	0.98	0.99	0.99	0.90	0.087
Modified model	2.32	1	2.32	0.99	0.93	0.99	0.99	0.99	0.95	0.063

As the results shown in Table 3 show, the indicators of the proposed model do not have a good fit with the data, therefore, to modify the proposed model, two adjustments are made on the model (creative writing and invention) and (creative writing and discovery). The goodness-of-fit indices obtained from the modified model are also presented in Table 3. As the results show, the goodness-of-fit indices include the relative chi-square (2.33), the goodness-of-fit index (GFI=0.99), comparative goodness of fit index (AGFI=0.94), Bentler-Bonnet index or soft fit index (NFI=0.99), comparative fit index (CFI=0.99), goodness of fit index Increasing (IFI=0.99), Tucker-Lewis index (TLI=0.95) and root mean square error estimation index (RMSEA=0.06), indicate a good fit of the proposed or assumed research model with the data finished or final has a favorable fit.

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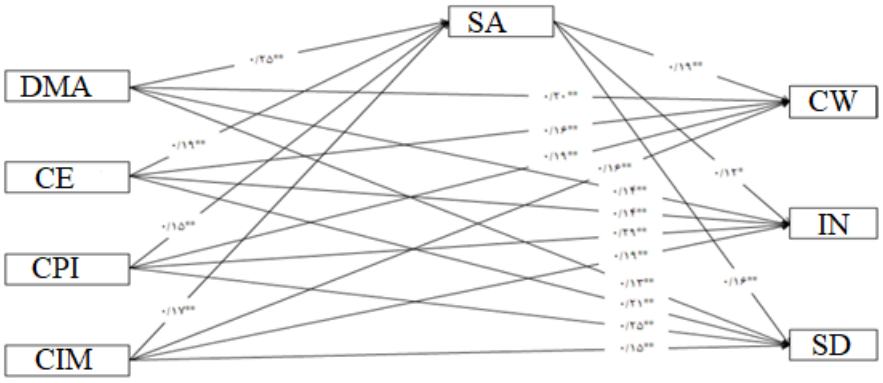


Figure 1. Beta coefficients related to the modified model (SA = self-actualization, DMA = dynamic mental attitude, CW = creative writing, CE = creative effectiveness, IN= invention, CPI = creative personal identity, CIM = Creative inner motivation, SD = scientific discovery)

Table 4. The results of bootstrap indirect coefficients by Preacher and Hayes method in the proposed model

Path	Data	Boot	Std. error	Low limit	High limit	P
Dynamic mental attitude → self-actualization → creative writing	0.1616	0.1609	0.0322	0.1019	0.2279	0.001
Creative effectiveness → self-actualization → creative writing	0.2401	0.2391	0.0500	0.1456	0.3498	0.001
Creative personal identity → self-actualization → creative writing	0.3016	0.2993	0.0553	0.2053	0.4246	0.001
Creative inner motivation → self-actualization → creative writing	0.3150	0.3142	0.0559	0.2228	0.4509	0.001
Dynamic mental attitude → self-actualization → invention	0.1462	0.1443	0.0320	0.0935	0.2222	0.001
Creative effectiveness → self-actualization → invention	0.2088	0.2068	0.0467	0.1263	0.3168	0.001
Creative personal identity → self-actualization → invention	0.2329	0.2289	0.0522	0.1473	0.3562	0.001
Creative inner motivation → self-actualization → invention	0.2611	0.2635	0.0605	0.1581	0.4019	0.001
Dynamic mental state → self-actualization → scientific discovery	0.1632	0.1628	0.0356	0.0954	0.2387	0.001
Creative effectiveness → self-actualization → scientific discovery	0.2174	0.2167	0.0473	0.1388	0.3336	0.001
Creative personal identity → self-actualization → scientific discovery	0.2708	0.2715	0.0609	0.1664	0.4094	0.001
Creative inner motivation → self-actualization → scientific discovery	0.3009	0.3010	0.0575	0.2018	0.4163	0.001

As the results in Table 4 show, the indirect relationship between dynamic mental attitude, creative effectiveness, creative personal identity and creative inner motivation with creative writing, invention and scientific discovery through self-actualization is significant. Next, in order to ensure the difference in the model's assumed paths in male and female students, multigroup path analysis method was used. The results of this study showed that the absolute value of the critical ratio of the path of self-actualization to invention is greater than 1.96, which indicates the existence of a significant difference in the mentioned path in male and female students. Figure 3 shows the

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comparative model of the causal relationship between creativity-oriented intrinsic motivation and creative achievements with the mediation of self-actualization in male and female students.

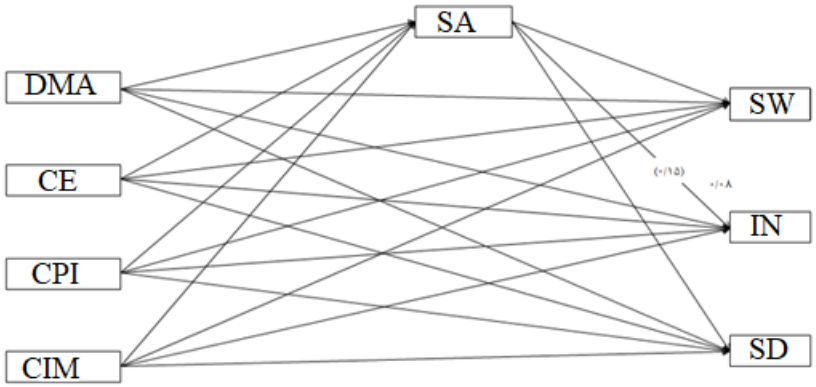


Figure 3. Comparison of gender in the research model (SA = self-actualization, DMA = dynamic mental attitude, CW = creative writing, CE = creative effectiveness, IN= invention, CPI = creative personal identity, CIM = Creative inner motivation, SD = scientific discovery)

As seen in Figure 3, the standard coefficients of the path between self-actualization and invention in this model for male students is β=0.15, while the coefficient of this path for female students is β=0.08. Therefore, the difference of this path in the two groups is confirmed in favor of male students.

Discussion

The objective of this study was to examine and contrast the causal relationship between creativity-oriented intrinsic motivation and creative accomplishments with the mediation of self-actualization among male and female high school students in the city of Yazd. In this investigation, all hypothesized direct pathways were validated. The outcomes indicated that a dynamic mental stance is connected to creative writing through self-actualization. This discovery aligns with prior research findings (Steele et al., 2017). To elaborate on this discovery, it can be posited that learners with a dynamic mindset utilize creative writing as a mechanism to express their ideas. Creative writing serves as a method for students to scrutinize, assess, and modify information and concepts. Students employ creative writing as a tool for logical thinking, deduction, and clarification (Sangsuk & Siriparp, 2015). Creative writing is a communal activity that occurs within a specific setting, serves a distinct purpose, and is crafted in a manner suitable for the intended audience and

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circumstances, thus fostering students' self-actualization as much as possible (Plucker et al., 2010). Furthermore, the findings revealed that creative efficacy is associated with creative writing through self-actualization. This result is consistent with previous research outcomes (Beck & Schmidt, 2012).

In elucidating the identified correlation, it can be posited that the approach of social constructivism in the realm of creative writing is grounded on the notion that students can comprehend writing better when the driving force is perceived as social rather than internal. Consider a cultural context where the student perceives their effectiveness as a creative individual. Social constructivism emphasizes the social milieu in which creative writing unfolds. When students engage in a community of writers to grasp the writer/reader dynamic and recognize the divergence in perspectives, it significantly contributes to enhancing the students' self-actualization of their capabilities and talents. The results exhibited that creative personal identity is linked to creative writing through self-actualization. This result is consistent with earlier research findings (Plucker et al., 2010). The rationale behind this finding is that creative personal identity entails having faith in one's creative potential. This conviction stems from an individual's cumulative thoughts, sentiments, and experiences throughout their lifetime. Students possessing a creative personal identity acknowledge the necessity of revising their writings to manifest their talent in creative writing. Revision entails composing multiple drafts, seeking feedback from proficient individuals in creative writing, and learning to assimilate feedback for enhancing their creative writing. Moreover, this process involves identifying and rectifying errors (Plucker et al., 2010).

The outcomes indicated that creative intrinsic motivation is associated with creative writing through self-actualization. This discovery corresponds with the findings of the study (Hennessey, 2010). When justifying these findings, it can be argued that highlights that students who possess internal creative drive utilize creative writing as a means of interpersonal communication. Creative writing involves generating texts that fulfill specific criteria and showcase students' expertise. Individuals driven by creative intrinsic motivation engage in writing not for external validation or attention, but for the inherent pleasure it brings, focusing on producing new knowledge that reflects the development of their skills.

The results demonstrated that dynamic mental attitude is linked to innovation through self-actualization. This result is consistent with the outcomes of the research (Steele et al., 2017). In

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elucidating this relationship, it can be posited that students with a dynamic mental outlook perceive life as a realm of choices geared towards advancement and development. Self-actualized individuals exhibit high levels of creativity and introduce innovative ideas in their work and various facets of life. They are adaptable and self-driven individuals who embrace making mistakes and deriving lessons from them. Self-fulfilled individuals are autonomous, self-reliant, and independent. They resist external pressures to conform to specific societal or cultural norms. While not openly challenging cultural conventions or social regulations, they are guided by their intrinsic nature rather than societal restrictions. Consequently, students with a dynamic mindset are inclined towards innovation and discovery, embodying characteristics that render them resolute and steadfast in pursuing their goals (Steele et al., 2017).

Additionally, the findings revealed that creative efficacy is connected to innovation through self-actualization. This outcome aligns with the research findings (Beck & Schmidt, 2012). The rationale behind these findings is that students' creative efficacy may stem from a blend of initiative, adaptability, and receptiveness to ideas, enabling learners to generate novel outcomes beyond conventional thinking patterns and engage in productive thought processes, leading to personal gratification and potentially satisfying others (Sternberg, 1999). According to humanistic perspectives, an innovation resulting from individuals' efficacy as creative and influential beings instills a sense of inner worth. Brandt et al. (2021) asserts that this is a component of achieving psychological well-being. Examining human nature as conscious, self-guided, and self-realizing, along with the stages of human action, contributes to mental well-being. Humanistic psychologists view scientific innovation as a holistic endeavor and believe that scientific breakthroughs inspire all aspects of life.

The outcomes indicated that the correlation between creative personal identity and invention is established through self-actualization. This discovery is consistent with the findings of a study conducted by Plucker et al. (2010). Sternberg (1999) argued that creative thinking encompasses three fundamental abilities, known as creative thinking levels. Among these abilities is the capacity for synthesis, which is synonymous with invention - the generation of innovative ideas and the establishment of connections between concepts. Another aspect of creative thinking is the ability to apply ideas effectively. Creative individuals persist with valuable ideas and utilize their practical skills to persuade others of the idea's worth. Consequently, students possessing a creative personal

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identity achieve self-actualization by amalgamating their knowledge and scientific skills, combining them, and applying them in the realm of scientific innovation.

The findings reveal a connection between creative intrinsic motivation and invention through self-actualization. This discovery aligns with the results of a study by Hennessey (2010). The acquired results can be elucidated by the fact that individuals with internal creative motivation readily acknowledge their strengths and weaknesses without distorting their self-image or feeling remorseful about failures. Self-actualized individuals exhibit individualistic opinions and ideals, yet their behavior is not necessarily unconventional. They possess enough confidence to express their true selves without excessive audacity. Another characteristic of individuals with creative intrinsic motivation is their focus on issues beyond personal concerns. Such individuals perceive a sense of duty or commitment that drives their energy expenditure. This commitment to an ideal or task is crucial for achieving self-actualization.

The results demonstrate a relationship between dynamic mental attitude and scientific discovery through self-actualization, which is consistent with the findings of a study by Steele et al. (2017). This finding can be explained by considering that, within the framework of creative problem-solving models, students engage in diverse problem-solving approaches with a dynamic mindset, fostering the generation of new and innovative ideas or insights, ultimately leading to scientific discoveries and the practical application of creativity. Research suggests that a dynamic mental attitude significantly influences students' attainment of scientific discoveries, enhancing their problem-solving skills and fostering self-actualization. Furthermore, the cultivation of problem-solving abilities through a dynamic mental attitude instills a general belief in students that challenges can be overcome by striving towards set objectives, thereby empowering students to realize their full potential and make greater scientific discoveries (Steele et al., 2017).

The outcomes indicated that the correlation between creative personal identity and scientific discovery is facilitated by self-actualization. This discovery aligns with the findings of a study conducted by Plucker et al. (2010). The results suggest that students possessing a creative personal identity exhibit a lucid and effective grasp of reality. Self-actualized students perceive the world, including others, objectively and without biases. Consequently, they can swiftly and accurately discern concealed or puzzling information in scientific domains, leading to scientific breakthroughs. The anticipations of students with a creative personal identity appear to be more

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accurate, as they are less influenced by emotions such as fear, worry, or optimism. These students embrace the unknown with ease, displaying a distinctiveness from the general populace. Their comfort with the unknown often sparks greater interest in it than in familiar phenomena ((Plucker et al., 2010).

Continuing with the investigation, the data from the study highlights a divergence in one specific pathway of the causal model linking motivational orientation towards creativity, self-actualization, and creative accomplishments in male and female students. A gender comparison within the model revealed a noteworthy variation in the pathway from self-actualization to innovation, with male students exhibiting higher levels than their female counterparts. This discrepancy can be elucidated by the fact that male students demonstrate less aversion to failure when confronted with unfamiliar challenges. Even in the event of failure, they adeptly pivot towards alternative solutions, enabling them to enhance their skills more efficiently and attain a heightened level of self-actualization.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by ethics committee of Shahid Chamran University of Ahvaz. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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