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Relationship of Dynamic Mindset, Creative Effectiveness and Creative Personal identity with Creative Writing, Invention and Scientific Discovery in Male and Female High School Students

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ABSTRACT

Objective: The objective of this study was to explore the relationship of dynamic mindset, creative effectiveness, and creative self-identity with creative writing, innovation, and scientific discovery among male and female high school students in Yazd city.

Methods: This investigation is a fundamental descriptive-correlational study. The statistical population for this study consisted of all male and female high school students in Yazd city in 2023, with 200 individuals chosen for assessing the research instrument's validity and reliability, and 340 participants selected as samples through a multi-stage random sampling approach. The research utilized questionnaires on creative achievement, dynamic mindset questionnaire, and creative effectiveness questionnaire as its measuring instruments. The data were analyzed using the Canonical correlation analysis method.

Results: The results revealed that Wilks's lambda value was significant ($F=24.544$, $\lambda=0.455$, $P<0.001$), indicating a canonical correlation between the two variable sets with a 99% probability. The effect size of the two focal functions in this analysis was 0.545, signifying the shared variance between the two variable categories that the present study can account for. The study findings suggest a substantial fundamental correlation (53%) between dynamic mindset, creative effectiveness, and self-identity with creative writing, innovation, and scientific discovery.

Conclusions: These findings can inform the development and implementation of interventions aimed at enhancing students' creativity.

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Introduction

Human civilization has historically relied on the inventive cogitation of individuals, with its perpetuation being unattainable sans the utilization of creativity, a faculty often deemed as the pinnacle of human cognitive processes. Creativity, characterized as a cognitive operation that engenders fresh ideas or concepts within the psyche, establishes novel associations amid preexisting ideas or concepts. The notions of originality and appropriateness are paramount in this discourse (Gibbons et al., 2018). Inner inspiration, though seemingly straightforward, actually unfolds as a multifaceted process. Scholars have delved into this process through the lenses of psychological behaviors and social psychology. Unlike various scientific phenomena, creativity lacks distinctive markers for explicating how it manifests in individuals; unlike numerous psychological phenomena, there exists no standardized criteria for evaluating the operational methodology in this domain. In the realm of creativity, a creative individual, a creative outcome, a creative procedure, and a creative origin or milieu all manifest as discrete constituents within the creative endeavor (Kelley & Kelley, 2013).

Creativity is frequently highlighted as a crucial aptitude to nurture among students in contemporary educational settings, attributing the innovative impacts of creativity on individuals and society (Fowler, 2006; Newton & Newton, 2014). Fostering creativity incites students' faculties, engenders erstwhile unknown knowledge, and enables students to amalgamate information while imbuing significance into their educational journey (DuPriest, 2017). Scholars posit that fostering students' creativity ought to stand as a pivotal educational objective in modern educational frameworks (Bahar et al., 2021; Maker et al., 2022; Maker et al., 2021). Kounios and Beeman (2009) delineated creativity as “the ability to reinterpret something by breaking it down into its elements and recombining these elements in a surprising way to achieve a goal” (p. 9). Put differently, the construct of creativity encompasses inventive ideas such as innovating, perceiving old entities from novel perspectives, uncovering fresh associations, and eliciting delightful astonishments (Maley & Bolitho, 2015). Starko (2021) expounds on the multifaceted nature of creativity, elucidating that diverse definitions exist. Some definitions scrutinize the attributes of individuals whose endeavors are deemed creative (what defines a creative individual?), while others scrutinize the works themselves (what renders them creative?)” (p. 12). For a more overarching elucidation, creativity embodies the capacity to think innovatively to tackle challenges

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and/or devise fresh ideas or products grounded on their aptness (Bullard & Bahar, 2023; Runco & Jaeger, 2012).

Creative achievements, as defined by Carson et al. (2005), refer to the collection of innovative products or works produced throughout an individual's lifespan. These achievements are evident in the endeavors of individuals whose creativity is deeply embedded in their being. A comprehensive definition of creative achievements entails recognizing them as outcomes of applying creativity across various domains to create novel and distinctive products. The development of creative achievements appears to be influenced by both intrapersonal and interpersonal elements. Intrapersonal factors, such as cognitive capacities (intelligence), personal traits (self-assurance, non-conformity), inner drive, and talent (Levy-Tossman et al., 2007), play a significant role in shaping creative achievements. The multifaceted nature of creative achievements underscores the importance of understanding the diverse variables affecting them to facilitate advancements and progress in this realm.

Individuals harbor varying beliefs regarding the adaptability of their personal attributes, encompassing intelligence, personality, ethics, and even specific traits like determination, interests, or sentiments (Tamir et al., 2007). These beliefs epitomize their implicit theories or mental predispositions. Dweck (2006) delineates two primary mindsets: the entity theory (or fixed mindset) posits that fundamental human attributes are static and impervious to change, while the dynamic theory (or growth mindset) asserts that such traits are modifiable and can undergo substantial development. Extensive literature consistently demonstrates that a growth mindset correlates with heightened goal achievement relative to a fixed mindset, particularly in challenging circumstances. Individuals embracing dynamic mental outlooks exhibit enhanced psychological well-being and reduced depressive symptoms. The superiority of dynamic mindsets over fixed mindsets predominantly stems from the conviction that perseverance and diligence can surmount obstacles and realize objectives (Dweck, 2006). Consequently, individuals with dynamic mental orientations tend to pursue learning-oriented goals, invest more effort in goal attainment, display greater adaptability and tenacity in the face of challenges, and respond more effectively to setbacks (Bernecker et al., 2017). Sternberg et al. (2023) underscores the significance of individuals' subjective interpretations of various constructs, revealing conceptual disparities in implicit theories concerning creativity and intelligence. This dynamic mental predisposition pertaining to

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creativity reflects the dichotomy between viewing creativity as an inherent trait (fixed mental cues) or a developable skill (Karwowski et al., 2020). Research by Plucker et al. (2017) further underscores the substantial overlap between implicit theories of intelligence and creativity.

In this particular context concerning constructs associated with creativity, reference can be made to self-efficacy, denoting individuals' beliefs in their capacity to successfully execute tasks at specific levels (Bandura & Schunk, 1981). The theory of self-efficacy by Bandura introduced the notion of creative efficacy, defined as the confidence in performing creative tasks (Tierney & Farmer, 2011). Individuals with heightened levels of creative efficacy hold more positive beliefs regarding their capabilities. Scientists in specialized domains demonstrate meticulous planning in scientific endeavors compared to those with lower creative efficacy levels (Tierney & Farmer, 2002). Addressing identity creativity issues, Vaz, Harty, Oden, and Isaacson (2019) suggest that identity is a multifaceted concept encompassing various types such as ethnic, occupational, social, educational, and creative personal identity. Creative personal identity involves the perception of creativity and a favorable attitude towards it (Tierney & Farmer, 2002), linked to dynamic and flexible creative abilities rather than fixed personal traits, positively correlated with a creative mindset and growth (Plucker, 2022).

Recent research indicates that creative personal identity significantly influences an individual's creative performance (Bandura, 2012; Karwowski et al., 2018). It has been explored as a stable and impactful construct in everyday creativity, evaluating the perceived importance of creativity to assess creative self-concept (Karwowski, 2016). Levels of creative personal identity are associated with confidence in one's creative potential (Karwowski, 2016) and the motivation to evolve through practice and time (Puente-Díaz & Cavazos-Arroyo, 2017). Given that individuals tend to align their actions with their values, a robust creative personal identity can serve as a driving force sustaining creative endeavors.

Álvarez-Huerta et al. (2022) demonstrated in a study a positive link between student motivation, creative efficacy, and self-actualization mediation. Steele et al. (2017) highlighted that while extrinsic motivation can initially prompt engagement in creative activities, it is internal motivation that exerts a lasting impact on goal achievement. Findings indicated a positive association between dynamic mental attitudes and self-actualization, whereas a negative correlation was observed with fixed mental attitudes. Beck and Schmidt (2018) revealed that students' creative beliefs, functional

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beliefs, and teachers' feedback were positively related to the quantity of students' scientific discoveries, while instances where teachers disregarded student input were negatively associated with students' reports.

Educational researchers always aim to explore and acknowledge the psychological variables that impact creativity and creative accomplishments. Enhancing creative achievements, nurturing creative self-concept, and sustaining creative endeavors can enhance and bolster creative self-confidence in individuals. Hence, there is a growing need to emphasize the development and enhancement of creativity among students to succeed in the realm of science. Simultaneously, recognizing the influencing factors can assist educational institutions, authorities, and students in configuring suitable educational settings to foster creativity. To date, no multivariate research has delved into the correlation of dynamic mindset, creative effectiveness, and creative self-identity with creative writing, innovation, and scientific discovery. Consequently, the ongoing study is examining the association between the composite effects of dynamic mindset, creative efficacy, and creative self-identity with creative accomplishments such as creative writing, innovation, and scientific discoveries among students.

Material and Methods

The present research is descriptive of the type of correlation. The statistical population of this research was made up of all male and female students of high schools in Yazd city in 2023. In order to test the research hypotheses and validate the research questionnaires, the sample was selected by multi-stage random sampling. The sampling method was that first, 2 areas were randomly selected from all areas of Yazd city. Then, three schools for boys and three schools for girls were selected from each region (12 schools in total). In the next step, 2 classes from each school (24 classes in total) and about 15 students from each class were randomly selected as samples. It should be mentioned that 200 subjects were selected as a sample to check the validity and reliability of the research tool and 340 people were selected as a sample for hypothesis testing. Research ethics were fully observed in this study in such a way that the participants were assured of the confidentiality of the information and they completed the questionnaires in a quiet environment without mentioning their names with full satisfaction. In order to measure the desired

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variables, creative achievement questionnaires, mental attitude questionnaires and creative effectiveness questionnaires were used. The data was analyzed using SPSS version 26 software.

Instruments

Creative achievements questionnaire: This questionnaire was prepared by Carson et al. (2005). This questionnaire has 96 items and evaluates 10 components of visual arts, music, dance, architectural design, sports teams, creative writing, invention, scientific discovery, film and theater, and cooking art, which in the current research, three components of it include creative writing, invention and scientific discovery, each of which includes 8 items, was used. This questionnaire is a self-report checklist in which the participant is asked to put a check mark next to the items that describe his achievements. The scoring of this questionnaire is from 0 to 7, in such a way that each domain includes an item "no achievement" with a weight of zero points, to "I have received professional training in this field". In their research, Carson et al. (2005) reported the reliability of this questionnaire using two test-retest and Cronbach's alpha methods as 0.81 and 0.96, respectively. Sangsuk and Siriparp (2015) in their research reported the reliability of this questionnaire using two test-retest and Cronbach's alpha methods of 0.69 and 0.71, respectively. In the current study, confirmatory factor analysis was also performed and the results showed that in the assumed model (Chi-square: 2.07), (IFI=0.89), (CFI=0.89), and (RMSEA=0.07) which are in an acceptable range and the reliability coefficient for creative achievements questionnaire was obtained through Cronbach's alpha method as 0.87 for creative writing, 0.85 for invention, 0.84 for scientific discovery and 0.93 for the whole questionnaire. In addition, the reliability coefficient for the creative achievements' questionnaire through the two-half method was obtained for creative writing 0.84, invention 0.88, scientific discovery 0.79 and for the entire questionnaire 0.86 respectively, which indicates an acceptable reliability.

Dynamic Mindset attitude questionnaire: This questionnaire was prepared by Karwowski et al. (2019). This questionnaire has 10 items and its answers are scored based on a five-point Likert scale from 1 (for definitely no) to 5 (for definitely yes). Based on this, the score range of this questionnaire is between 10 and 100. Karwowski et al. (2019) have reported the reliability coefficient of this questionnaire through Cronbach's alpha method as 0.87. In the present study, confirmatory factor analysis was also performed and the results showed that in the assumed model (Chi square: 1.72), (IFI=0.96), (CFI=0.96), and (RMSEA=0.06) which are in an acceptable range,

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and the reliability coefficient for the dynamic mindset attitude questionnaire was obtained through the Cronbach's alpha method of 0.85 and through the two-half method, 0.81.

Creative Effectiveness Questionnaire: This questionnaire was prepared by Karwowski et al. (2013). This questionnaire has 11 items, it measures the two components of creative effectiveness (6 items) and creative personal identity (5 items), and its answers are based on a five-point Likert scale from 1 (for completely false) to 5. (for completely correct) are scored. Karwowski et al. (2013) in their research have reported the reliability coefficient of this questionnaire through Cronbach's alpha method for creative effectiveness of 0.87 and for creative personal identity of 0.85. In the current study, confirmatory factor analysis was also performed and the results showed that in the assumed model (Chi-square: 1.47) (IFI=0.96), CFI=0.96, and (RMSEA=0.05) that they are in an acceptable range, and the reliability coefficient for the creative effectiveness questionnaire was obtained through Cronbach's alpha method, 0.72 for creative effectiveness, 0.78 for creative personal identity, and 0.81 for the entire questionnaire. In addition, the reliability coefficient for the creative effectiveness questionnaire was obtained through the two-half method, respectively, for creative effectiveness 0.72, creative personal identity 0.78, and for the entire questionnaire 0.63.

Mean, standard deviation and correlation coefficient were used to analyze the obtained data at the level of descriptive statistics and canonical correlation coefficient was used at the level of inferential statistics.

Ethical considerations

In order to comply with the ethical standards of the research, in addition to the necessary guidance provided in the instructions of the questionnaires, the participants were assured that the information will be used only in line with the objectives of the study and without mentioning the identity details, the participants gave the informed consent form to participate in the research. also completed.

Results

Table 1 shows the descriptive indices related to the scores obtained by the participants in the research variables.

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Table 1. Mean, standard deviation and correlation coefficients between the variables of the present study

	Variable	Mean	SD	1	2	3	4	5	6
1	Dynamic mindset	33.53	10.40	-					
2	Creative effectiveness	13.30	6.70	0.36**	-				
3	Creative personal identity	10.78	4.92	0.28**	0.32**	-			
4	Creative writing	29.99	12.44	0.45**	0.42**	0.41**	-		
5	Invention	29.19	12.74	0.40**	0.40**	0.48**	0.45**	-	
6	Scientific discovery	29.12	12.77	0.41**	0.44**	0.46**	0.46**	0.44**	-

** p < 0.01

As the results in Table 1 show, the correlations between dynamic mindset and creative writing (r=0.45, p<0.01), creative effectiveness and creative writing (r=0.42, p< 0.01), creative personal identity and creative writing (r=0.41, p<0.01), dynamic mental attitude and invention (r=0.40, p<0.01), creative effectiveness and invention (r=0.40, p<0.01), creative personal identity and invention (r=0.48, p<0.01), dynamic midset and scientific discovery (r=0.41, p<0.01), creative effectiveness and scientific discovery (r=0.44, p<0.01) and creative personal identity and scientific discovery (r=0.46, p<0.01). Table 2 shows the results of canonical correlation model analysis for variables of dynamic mindset, creative effectiveness and creative personal identity with creative writing, invention and scientific discovery.

Table 2. The results of the canonical correlation model analysis for dynamic mindset, creative effectiveness and creative personal identity with creative writing, invention and scientific discovery

Test	Value	DF	Error DF	F	P
Pillai's trace	0.552	9	1008	25.277	0.001
Hotelling's Trace	1.183	9	998	43.748	0.001
Wilk's Lambda, and.	0.455	9	813.02	24.544	0.001
Roy's largest root	0.539	-	-	-	-

As can be seen in Table 2, the significance of Wilks's lambda value (F=24.544, λ=0.455, P<0.001) shows that there is focal correlation between two sets of variables with a probability of 99%. Wilkes' lambda shows the amount of variance that is not explained by the model, as a result, 1-λ reveals the effect size of the complete model in the r matrix. Based on this, the effect size of the two focal functions of this analysis is equal to 0.545, the effect size is the common variance value between the two categories of variables, which the complete model is able to explain. Therefore, the obtained model shows that there is a common source of variance that explains the overlap of two categories of variables; The amount of this variance is 0.545.

The first statistical step in canonical analysis is to extract one or more focal functions. In this research, considering that there are three independent variables and three dependent variables, the

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number of extracted roots or functions is the same (three focal functions). Table 3 shows the characteristics of the functions resulting from focal analysis in this research.

Table 3. Features of functions resulting from focal analysis

Function	Eigen value	Percentage	Cummolative percentage	Canonical correlation	R^2
1	1.17	98.877	98.877	0.734	0.539
2	0.011	0.957	99.834	0.106	0.011
3	0.002	0.166	100	0.044	0.002

As can be seen in Table 3, the canonical correlation square (R^2c) of the functions is equal to 0.539, 0.011 and 0.002 respectively. Functions that explain less than 10% of the common variance should be discarded and not interpreted. Therefore, the first function, which explains 53.9% of the common variance, is interpreted, but the second and third functions are not interpreted. Also, the results of Table 3 show that the simple correlation between the first combined variable obtained from independent variables and dependent variables is equal to 0.734. In addition to this method, the significance test of functions with the help of dimension reduction analysis also allows the researcher to test their significance with the help of hierarchical arrangement of functions. Table 4 shows the results of the dimension reduction analysis of the triple functions of this research.

Table 4. Dimension reduction analysis results for focal distribution

Function	Wilk's Lambda	F	DF	Error DF	P
1	0.455	34.544	9	813.02	0.001
2	0.987	1.111	4	670	0.350
3	0.998	0.660	1	336	0.417

As the results in Table 4 show, based on the results of the F test, only one of the focal functions is significant ($F = 813.02$, $P < 0.001$, $\lambda = 0.455$). The second function ($F=1.111$, $P<0.350$, $\lambda=0.987$) and the third function ($F=0.660$, $P<0.417$, $\lambda=0.998$) are not significant. In this research, three focal dimensions were considered and it was calculated that only one of them is statistically significant. The first dimension test deals with whether all three dimensions are statistically significant. ($F=813.02$, $P<0.001$). These three multivariate tests of the general model between two groups of variables. In other words, these tests evaluate the common variance between independent and dependent variables at the levels of all underlying functions (resulting from three pairs of combined variables).

Investigating the main hypothesis of the research (the relationship between dynamic mindset attitude, creative effectiveness and creative personal identity with creative writing, invention and

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scientific discovery) is possible through the analysis of focal variables. The analysis of the focal variables is done by examining the standard and structural coefficients. As the results of Table 2, the research hypothesis is confirmed and there is a significant relationship between dynamic mindset, creative effectiveness and creative personal identity with creative writing, invention and scientific discovery. Table 5 shows the standard coefficients, structural coefficients and their square (explained variance). In this table, the focal or structural load is a sign of variable correlation with the focal variable. Standardized focal coefficients are the same as standardized regression coefficients in regression analysis and show the importance of the variable in the set.

As the results in Table 5 show, in the first function, the criteria linear variables are: creative writing, invention and scientific discovery. On the other hand, in this function, all three predictor variables of dynamic mental attitude, creative effectiveness and creative personal identity are significant and contributory in the predictor linear variable. In other words, so far it shows that according to the first function, creative writing, invention and scientific discovery are better predicted by dynamic mental attitude, creative effectiveness and creative personal identity. Therefore, the main research hypothesis is confirmed. In Table 5, the structural coefficient (focal load) shows the correlation between the criterion variable and the focal variable. Standardized focal coefficients are the same as standardized regression coefficients in regression analysis and indicate the importance of the variable in the set. In the set of criterion variables, scientific discovery (0.44) and in predictor variables, creative personal identity (0.53) have the most importance. Also, explained variance is the amount of variance that each set explains its focal variable. In this study, the weight of the common variance among this group of variables is equal to 54%, which is significant with the value ($F=34.544$, $P<0.001$).

Table 5. Standard, structural and their squared coefficients in the first function

Variable	Standardized coefficient	Structural coefficient	Structural coefficient square
Dynamic mindset	0.391	0.787	0.619
Creative effectiveness	0.418	0.790	0.624
Creative personal identity	0.445	0.810	0.656
Creative writing	0.425	0.717	0.514
Invention	0.394	0.718	0.515
Scientific discovery	0.531	0.776	0.602

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To identify significant variables in sets or focal variables, a focal load of 30% or more of each variable is a sign of its significance in its own set, because if it is less than 30%, the amount of overlap will be very low. Therefore, the significant variables in the set of scientific discovery criterion variables are 0.81, invention 0.79, and creative writing 0.79, and in total, the predictive variables of creative personal identity are 0.78, creative effectiveness 0.72, and dynamic mindset 0.72

Discussion

This study was undertaken with the objective of exploring the central correlation between dynamic mindset, creative efficacy, and creative self-identity in relation to creative writing, innovation, and scientific discoveries, aiming to address the query of whether a correlation exists between dynamic mindset, creative efficacy, and creative self-identity with regards to the relationship between creative writing, innovation, and scientific discoveries. The outcomes of this investigation reveal a significant correlation and substantial intersection (53%) between dynamic mindset, creative efficacy, and creative self-identity in connection to creative writing, innovation, and scientific discoveries. Indeed, creative writing, innovation, and scientific discoveries exhibit predictability and share a meaningful association through dynamic mindset, creative efficacy, and creative self-identity. Consequently, the primary hypothesis of this current study is upheld. The study results demonstrate that dynamic mindset have a favorable association with creative writing in both male and female students. To put it differently, the aforementioned pathway was validated. This discovery aligns with findings from various studies such as Steele et al. (2017), Karwowski et al. (2019)), Levy-Tossman et al. (2007), and Dweck (2006). When interpreting the obtained outcome, it can be posited that dynamic mindset represent an individual's envisioned capacity to attain goals through effort, aligning them with their capabilities. Students who possess confidence in their abilities can effectively navigate challenges and articulate their ideas in a diverse and innovative manner using suitable language. A dynamic mindset emerges as a fundamental necessity that significantly influences life processes, particularly in the realm of education and training, as it fosters personal development, flourishing, and creativity (Dweck, 2006).

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The study findings demonstrate that in male and female students, creative efficacy exhibits a positive association with creative writing. In other words, the aforementioned path was validated. This observation is consistent with findings from studies such as Tierney and Farmer (2002) and Levy-Tossman et al. (2007). The acquired results can be elucidated by noting that students with heightened levels of creative efficacy harbor positive beliefs regarding their creative writing prowess within specialized and scientific domains, indicating a heightened interest in the discipline. They tend to overlook minutiae in scientific fields compared to peers with lower creative efficiency. Furthermore, students with elevated levels of creative efficacy are more inclined to engage in extracurricular group activities outside of school. Students leverage their creative efficacy in influencing decisions, opting for tasks that evoke satisfaction, comfort, and confidence, while avoiding those that pose challenges beyond their capacity (Schneider et al., 2013).

The outcomes of the study revealed that among male and female students, possessing a creative personal identity is positively correlated with engaging in creative writing. Put differently, the aforementioned pathway was validated. This discovery aligns with findings from various researches such as Plucker et al. (2017) and Mohammadi and Asghari Ibrahimabad (2020). The argument that can be put forth to elucidate this discovery is that the primary method to engage in creative writing is to identify one's writing challenges. Consequently, students who possess a clear comprehension of their creative identity cultivate effective writing practices and enhance their writing skills. Moreover, students with a creative personal identity often challenge themselves and their writings when faced with adversity, strive to rectify and enhance their work to the best of their ability, and even if their writing does not receive approval from others, they exhibit the least defensive stance by embracing constructive feedback from experts and endeavoring to address the identified issues (Mohammadi & Asghari Ibrahimabad, 2020).

The findings of the investigation demonstrated that within male and female students, harboring a dynamic mindset is positively associated with fostering creativity. In essence, the aforementioned path was substantiated. This conclusion is consistent with the results of several studies including Steele et al. (2017), Karwowski et al. (2019), Levy-Tossman et al. (2007) and Dweck (2006). To explicate the observed correlation, it can be argued that students with a fixed mental attitude tend to view mistakes as failures and are reluctant to persist in facing challenges. Consequently, these

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students shy away from challenges and exhibit a diminished interest in fostering creativity due to the belief that their intelligence is inherently limited by their failures. Hence, educators must guide students towards the understanding that scientific creativity and innovation are attained through maximal effort, employing suitable strategies, embracing challenges, and welcoming feedback from peers. Students characterized by a dynamic mindset relish challenges and acknowledge that in order to acquire new knowledge or innovate, they must exert effort. Even individuals with low self-assurance in their intellectual capabilities, yet possessing a dynamic mental attitude, excel in demanding circumstances (Dweck, 2006).

The findings of the study revealed that among male and female students, the concept of creative self-perception is positively correlated with the act of innovation. Stated differently, the aforementioned pathway was validated. This discovery aligns with findings from various research works such as Plucker et al. (2017) and Mohammadi and Asghari Ibrahimabad (2020). An explanation for this outcome is that Plucker et al. (2017) connect creative self-perception with creative capabilities, asserting that self-definition, optimism, teacher conduct, and curiosity are frequently linked with creative self-perception. Plucker and Mackel's research emphasize that creativity plays a vital role in self-definition and argues that creative self-perceptions are significantly more dynamic and adaptable compared to fixed personal traits. Furthermore, they suggest that creative self-perception correlates positively with a growth mindset focused on creativity and particularly with the act of invention.

The outcomes of the investigation demonstrated that within male and female students, possessing a dynamic mindset exhibits a favorable association with scientific exploration. Put differently, the previously mentioned route was validated. This discovery is consistent with findings from several studies such as Steele et al. (2017), Karwowski et al. (2019), Levy-Tossman et al. (2007), and Dweck (2006). It can be asserted in this context that students characterized by dynamic mindset display heightened capacities for scientific exploration. The superiority of dynamic mindsets over fixed mindsets is primarily ascribed to the belief in one's ability to surmount obstacles and attain objectives through persistent effort (Dweck, 2006). Consequently, students with dynamic mental orientations are inclined towards embracing learning objectives over performance objectives, investing greater effort towards goal achievement, demonstrating increased adaptability and

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perseverance in the face of challenges, and reacting more effectively in the event of setbacks (Bernecker et al., 2017).

Moreover, the findings of the study suggest that there exists a positive correlation between creative efficacy and scientific exploration in both male and female students. Stated differently, the aforementioned pathway has been validated. This discovery aligns with previous research outcomes such as Tierney and Farmer (2002) and Levy-Tossman et al. (2007). To elucidate this outcome, it can be argued that individuals' perceptions of their creative efficacy impact cognitive processes in diverse ways. The personal objectives set by individuals are influenced by their self-assessment of capabilities. When individuals perceive their self-efficacy to be higher than their set goals, they are motivated to surpass challenges and consequently exhibit a greater commitment towards accomplishing their objectives. Self-efficacy beliefs play a role in influencing motivational and self-regulatory mechanisms through various avenues. Students exhibiting high levels of creative efficacy tend to harbor optimistic views regarding their scientific competencies in specialized domains, indicating their capacity for more strategic planning compared to peers with lower creative efficacy levels. Refer to Tierney and Farmer (2002) for further insights.

The outcomes of the investigation revealed a positive association between creative personal identity and scientific discovery among male and female students. Put differently, the aforementioned route was validated. This discovery is consistent with findings from studies such as Plucker et al. (2017) and Mohammadi and Asghari Ibrahimabad (2020).

It is worth noting that students with a creative personal identity invest time in comprehending the issue at hand, understand the criteria for effective decision-making, and make sound judgments. Furthermore, students possessing a creative personal identity demonstrate adept decision-making skills tailored to current requirements, exhibit meticulous planning, and proficient execution. Individuals with a creative personal identity are adept at identifying counterproductive thoughts hindering goal attainment, eliminating such barriers, enhancing their ability to forecast solutions, making informed decisions, and utilizing problem-solving skills to engage in scientific exploration within their areas of proficiency (Plucker et al., 2017).

In the present study, limitations were identified in the research implementation method, thus, data collection in this study was conducted through survey methodology. An issue frequently encountered with this method is the common method bias, leading to potential inflation of

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observed associations (Podsakoff et al., 2003). Moreover, the correlational design of these analyses precludes the ability to draw causal conclusions.

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 the ethics committee of the 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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