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The Roles of Generic and Domain-Specific Mindsets in Learning Graphic Design Principles

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Abstract

It is possible that individuals do not endorse a general mindset or theory of intelligence and that their mindset is specific to particular domains. There is currently a dearth of evidence to support this possibility. It is also not known how these two types of mindset influence learning behaviors and outcomes. This study investigates the roles of generic mindsets (i.e., beliefs about general ability) and domain-specific mindsets (i.e., beliefs about domain-specific abilities) in students' learning graphic design principles. Pre-service teachers (n = 107) played an online assessment game in which they designed three posters. For each poster, they had three chances to seek critical (i.e., constructive) feedback and one chance to revise their posters. Students' poster performance was measured by the game, whereas their learning of graphic design principles was measured by a post-test. Results show that critical feedback-seeking moderated the relation between generic and domain-specific growth mindsets. Critical feedback-seeking improved learning outcomes only when students endorsed a weak fixed generic mindset. Theoretical implications suggest that generic and domain-specific mindsets are distinct psychological constructs, and that generic mindsets seem to be more important than domain-specific mindsets in predicting learning of graphic design principles.

Keywords: mindset, feedback seeking, revision, performance, assessment game

Introduction

Cultivating productive learning behaviors, such as seeking critical feedback (i.e., negative but constructive feedback) or revising one's work, is important in improving individuals' performance and learning outcomes (Smith, Iversen, & Hjorth, 2015). However, the link between feedback and performance is multifaceted, as feedback may not work the same way for all individuals and it may not always benefit performance and learning (Lam, Huang, Snape, 2007; Morrison & Weldon, 1990; Van Dijk & Kluger, 2011). Many individual factors can impact students' engagement with feedback as well as their learning outcomes (De Stobbeleir, Ashford, & Zhang, 2020). For example, mindsets or self-theories (i.e., beliefs individuals hold about their own abilities or intelligence) are important psychological factors that may influence students' learning behaviors and outcomes (e.g., class performance; Dweck, 1999). A growth mindset is an incremental theory of intelligence, and those who endorse a growth mindset hold the belief that intelligence and ability are malleable traits that can be further developed through effort. A fixed mindset is an entity theory of intelligence, and those who endorse a fixed mindset hold the belief that intelligence and ability are fixed traits.

More recently, the mindset literature has distinguished between generic mindsets and domain-specific mindsets, with regards to individuals' beliefs about their general or domain-specific abilities, respectively (Furnham, 2014). Particularly, generic mindsets refer to individuals' beliefs about general ability (e.g., intelligence), whereas domain-specific mindsets refer to individuals' beliefs about domain-specific abilities (e.g., mathematics). However, the relationship between the generic and the domain-specific mindsets is not clear. It is conceivable that cultivating a generic growth mindset may influence not only students' learning behaviors but also their mindsets in a particular domain. For example, given that students who endorse a generic growth mindset are more likely to make use of critical feedback to improve their

learning, they may also be more likely to believe that feedback can help them improve their abilities in a certain task domain. In this case, a generic growth mindset could be associated with a domain-specific growth mindset. In contrast, the performance of those who endorse a generic fixed mindset may be negatively affected after receiving critical feedback, because criticism may reinforce their domain-specific fixed mindset, leading them to believe that they are also less likely to improve in a particular task domain (Leith, Ward, Giacomin, Landau, Ehrlinger, & Wilson, 2014). For example, students endorsing a generic fixed mindset may avoid revising their work after receiving criticism, as they do not believe they can improve regardless of the task domain. To date, it is not clear which type of mindset, generic or domain-specific, is more important for students' learning performance in a specific domain. The inconsistent findings in the research literature (see Simon et al., 2008) suggest that the link between generic and specific mindsets is worth exploring.

Study Contribution

In the current study, we examine whether the link between generic and specific mindsets is influenced by students' learning behaviors (i.e., critical feedback-seeking and revising posters) and learning outcomes within the domain of digital poster design, as illustrated in Figure 1. This study contributes to our understanding of the relation between generic and specific mindsets, as well as their individual relations with learning behaviors and learning outcomes. To our knowledge, this is the first study that examines the relation between generic and specific mindsets as well as the relation of these types of mindsets with learning behaviors and outcomes for pre-service teachers.

For instance, students with stronger generic growth mindsets may be more likely to make use of constructive feedback to revise their poster designs and, thus, to improve their

performance. As a result, they may be more likely to believe that they can improve their ability to design posters. In addition, research shows that fixed and growth mindsets may be better represented as two separate factors because they could predict different motivational processes (Lou, Masuda, & Li, 2017). For example, fixed mindsets may better capture the negative emotion in learning (e.g., anxiety), while growth mindsets may better predict positive emotion (e.g., confidence; King, 2012). Similarly, fixed and growth mindsets play a different role in learning behaviors and outcomes in graphic design (Cutumisu & Lou, 2020). Therefore, in the present research study, fixed and growth mindsets are considered to be two separate dimensions of the mindset construct rather than a mindset continuum. We pose the following questions:

1) Are generic and specific mindsets associated with each other and is critical feedback-seeking moderating this relation for both fixed and growth mindsets?

2) Does revision mediate the link between critical feedback-seeking and learning outcomes (performance and post-test)?

3) Do generic and specific mindsets moderate the link between learning behaviors (critical feedback-seeking and revising) and learning outcomes (performance and learning)?

Theoretical Framework

Fixed versus Growth Mindsets

Carol Dweck (1999) distinguishes two types of mindsets about ability: fixed and growth. A fixed mindset refers to the belief that ability is predetermined and cannot be changed, whereas a growth mindset refers to the belief that ability is malleable and thus can be improved through effort. Research shows that students who endorse a fixed mindset tend to attribute performance to their ability and to focus on information that validates their performance, whereas students who endorse a growth mindset tend to attribute their performance to effort and learning

strategies, and to focus on information about their learning process (e.g., how to improve their ability; Lou & Noels, 2016; Yeager & Dweck, 2012). Therefore, students who endorse a growth mindset are more likely to utilize critical feedback to improve performance and, thus, to outperform those who endorse a fixed mindset. In contrast, a fixed mindset may undermine the effectiveness of critical feedback.

Generic versus Domain-Specific Mindsets

Although mindsets most often refer to beliefs about one's general ability, they can also be domain-specific. Similar to self-efficacy that is specific to behaviors and their context of occurrence (Bandura, 1986; 1997), it is possible that a different mindset is endorsed for each type of ability. Specifically, it is possible that individuals are not self-efficacious or that they do not endorse a fixed or growth mindset in general, but rather that their efficacy or mindset is specific to particular domains of functioning (Maibach & Murphy, 1995). Indeed, it is believed that learners hold various beliefs about their abilities regarding general intelligence or domain-specific intelligence (Lee, Heeter, Magerko, & Medler, 2012). For example, some students may think that verbal intelligence is malleable but that music or mathematics intelligence is relatively fixed (Furnham, 2014; Lou & Noels, 2017; Shively & Ryan, 2013).

Although generic mindsets and domain-specific mindsets are often correlated, research shows that the domain motivation (e.g., language-learning motivation) is associated more strongly with mindsets particular to a domain (e.g., mindsets about language ability) than with generic mindsets (e.g., Lou & Noels, 2017; Lee et al., 2012). For instance, in the field of computer science, research shows that mindsets about programming predict programming effort more strongly than generic mindsets (Scott & Ghinea, 2014). Several studies showed that generic mindsets also predicted domain-specific learning behaviors and outcomes, such as mathematics

or science learning behaviors (e.g., Flanigan, Peteranetz, Shell, & Soh, 2017; Greene, Costa, Robertson, Pan, & Deekens, 2010; Hong, Chiu, Dweck, Lin, & Wan, 1999).

Some studies even showed that generic mindsets, but not domain-specific mindsets, predict learning behaviors, such as help-seeking and persistence in learning mathematics (Shively & Ryan, 2013). Additionally, teachers' mindsets may also influence their students' views on ability in various domains. For instance, it was found that elementary-school teachers' fixed mindsets regarding mathematics ability predict lower intrinsic motivation but only for low-achieving students in a large sample of fourth-grade students (Heyder, Weidinger, Cimpian, & Steinmayr, 2020). Also, instructors may create feedback that is growth-mindset oriented, which was found to lead to students' increased performance on a final exam in an introductory-programming class (Cutts, Cutts, Draper, O'Donnell, & Saffrey, 2010). There is a paucity of research exploring the links of both generic and domain-specific mindsets with learning behaviors and outcomes, thus more investigation is warranted.

Method

Participants and Procedure

Participants were n = 107 (97 females and 10 males; M_{age} = 23.76, SD_{age} = 5.20) pre-service teachers (undergraduate students enrolled in an Education program) at a large University in Western Canada. They completed an online informed consent form, followed by the generic mindset survey shown in Table 1, and played the Posterlet assessment game (Cutumisu, Blair, Chin, & Schwartz, 2015) in which they designed three digital posters for a fictitious Fun Fair and sought either critical (i.e., negative) or confirmatory (i.e., positive) feedback from animal characters in the game on their posters. Then, players had one chance to revise each poster. After each poster, players would see the amount of tickets sold by their poster booth, which represents

the poster performance measure. We selected this assessment instrument for our study, as it presents several advantages. First, the game is not testing academic subjects linked to the curriculum. Instead, it features a creative poster design task on which players display a uniform initial performance as measured by the first poster they designed in the game, before a chance for feedback or revision. Second, the game measures students' performance on an open-ended task, which is more reflective of a type of a problem encountered in the real-world than a procedural task. Concomitantly, the game computes the score of each poster in a principled way, based on 21 rules of graphic design (e.g., the contrast between the colors of the font and poster background is too low, the font size is too small, or the location of the fair is missing from the poster, etc.). Third, the game also collects two behavioral measures: (1) the number of times players choose to read critical versus confirmatory feedback about their posters (ranging from 0 to 9, as there were three chances to seek feedback on each of the three posters) and (2) the number of times players choose to revise the three posters (ranging from 0 to 3, as there was one chance to revise each poster). Finally, $n = 100$ of the students also completed the post-test that included the domain-specific mindset survey (i.e., theories of intelligence about the domain of poster design) shown in Table 2.

Materials

Mindsets. Students' mindsets were measured using four items (two for growth mindset and two for fixed mindset). Before playing the Posterlet game, participants filled out a mindset questionnaire that referred to their generic theories of intelligence. After the game, participants filled a mindset questionnaire that referred to their theories of intelligence specific to the poster design domain.

Generic Fixed Mindset represents the sum of the two fixed-mindset items completed by students before the game, which referred to generic entity theories of intelligence. *Generic Growth Mindset* represents the sum of the two growth-mindset items completed by students before the game, which referred to generic incremental theories of intelligence. All these questions are shown in Table 1.

Specific Fixed Mindset represents the sum of the two fixed-mindset items completed by students after the game, which referred to entity theories of intelligence specific to the poster design domain. *Specific Growth Mindset* represents the sum of the two growth-mindset items completed by students after the game, which referred to incremental theories of intelligence specific to the poster design domain. All these questions are shown in Table 2.

The internal consistency values based on inter-item correlations (two items for each construct) are satisfactory: *r*s = .57, .60, .41, and .44 for generic growth mindset, generic fixed mindset, specific growth mindset, and specific fixed mindset, respectively.

Data Analysis Plan

Descriptive analyses (e.g., mean, standard deviation, skewness, and kurtosis) were first conducted for all the variables and the assumptions for all analyses were tested. Second, non-parametric paired-samples Wilcoxon t-tests were conducted to examine the differences between generic and specific mindsets. Finally, regression analyses were conducted to examine our hypothesis that changes in critical feedback, revision, and performance are associated with changes from generic to specific mindsets. Three latent growth models that examined the change of critical feedback-seeking, revision, and performance were also built. However, possibly due to the sample size, we did not find any significant variance regarding the intercept on critical feedback-seeking and revision, thus we did not include these analyses in this study.

Results and Discussion

Descriptive Analyses

The descriptive statistics of key variables are presented in Table 3. Spearman correlations were conducted, as the mindset variables were not normally distributed. Results indicated that there was no association between generic and specific growth mindsets, whereas generic and specific fixed mindsets were positively correlated. Taken together, these results suggest that students' generic and specific mindsets are markedly distinct constructs.

Tests of Outcome Differences (Non-parametric Wilcoxon Tests)

Non-parametric paired-samples t-tests (Wilcoxon tests) were conducted to compare students' generic mindsets with their specific mindsets. As shown in Table 4, findings suggest that participants endorsed significantly weaker domain-specific fixed mindsets than generic fixed mindsets ($Z = -2.40$, $p = .02$) and significantly stronger domain-specific growth mindsets than generic growth mindsets ($Z = -2.66$, $p < .01$). The mindset variables range from 2 to 10. The median rating was 4 for generic fixed mindsets and 3 for domain-specific fixed mindsets. The median rating was 9 for generic growth mindsets and 10 for domain-specific growth mindsets. These results suggest that students' domain-specific mindsets are stronger for growth mindsets and weaker for fixed mindsets than their generic mindsets. It seems plausible that, in comparison with the generic mindsets assessed before the game, individuals' domain-specific mindsets would change by the end of the game (their growth mindset would strengthen and their fixed mindset would weaken), as players would be more self-assured after learning about poster design through feedback in the game and seeing how their performance increased from poster to poster (i.e., the "tickets sold" value increased for all participants throughout the game). However, as participants' domain-specific mindsets were only measured after the game, it is not clear whether

they would be different before the game, even if the game was short and it did not include any mindset interventions. In future research, mindsets (specific and generic, growth and fixed) will be measured before the game as well as after the game.

This result echoes a similar finding in a sample of freshman engineering students, which revealed that the incorporation of open-ended design experiences, similar to the creative tasks fostered by the Posterlet game, had a significant impact on their mindset changes from the beginning to the end of their first year in their engineering program (Reid & Ferguson, 2014).

Regression analyses

To examine whether critical feedback-seeking moderates the link between generic and specific mindsets, we conducted two regression analyses on growth mindsets and fixed mindsets, respectively, using the PROCESS macro (Hayes, 2012) in SPSS (2017). Only $n = 100$ students were included in these analyses, as they provided answers to both the generic and the specific mindset surveys.

Regarding fixed mindset, we found that the model was significant: $R^2 = .09$, MSE = 1.64, $F(3, 96) = 3.34$, $p = .02$. The link between generic and specific fixed mindsets was also significant ($n = 100$, $b = .25$, $SE = .10$, $t = 2.54$, $p = .01$), but it was not moderated by critical feedback-seeking ($n = 100$, $b = -.08$, $SE = .06$, $t = -1.38$, $p = .17$), as shown in Figure 2. This link was also not moderated by students' choice to revise ($n = 100$, $b = .02$, $SE = .09$, $t = 0.19$, $p = .85$) or by their poster performance (controlling for the pre-test; $n = 100$, $b = -.01$, $SE = .02$, $t = -0.47$, $p = .64$). This result suggests that learning behaviors and performance do not seem to influence individuals' endorsement of a fixed mindset, be it generic or domain-specific, perhaps as they hold the belief that abilities are fixed regardless of strategies used to tackle the task at hand.

Regarding growth mindset, we found that the model was significant: R^2 = .10, MSE = 1.07, $F(3, 96) = 3.74$, p = .01. The link between generic and specific growth mindsets was also significant (n = 100, b = .25, SE = .10, t = 2.57, p = .01) and it was moderated by critical feedback-seeking (n = 100, b = 0.15, SE = 0.06, t = 2.69, p = .01). A simple-slope analysis showed that students' generic growth mindset significantly predicted their specific growth mindset for those who sought critical feedback more often (+1SD; b = .53, SE = .16, t = 3.35, p = .001) but not for those who sought critical feedback less often (-1SD; b = -.03, SE = .13, t = -.21, p = .84). This seems to indicate that, when individuals endorse a stronger growth mindset, learning strategies such as seeking critical feedback about one's work strengthen the relation between generic and domain-specific mindsets. This suggests that individuals who endorse a growth mindset may recognize the importance of using productive learning strategies to improve their performance. Moreover, another simple-slope analysis showed that critical feedback-seeking positively but marginally significantly predicted students' domain-specific growth mindset if participants also held a strong generic growth mindset (+1SD; b = 0.16, SE = .08, t = 1.93, p = .057). In contrast, critical feedback-seeking negatively predicted students' domain-specific growth mindset if participants endorsed a lower generic growth mindset (+1SD; b = -0.16, SE = .08, t = -2.03, p = .045). However, the link between generic and specific growth mindsets was not moderated by students' choice to revise (n = 100, b = .07, SE = .08, t = 0.84, p = .41) or by their performance (controlling for the pre-test; n = 100, b = .002, SE = .01, t = 0.11, p = .91). Taken together, these results indicate that revision and performance do not seem to impact the relation between generic and domain-specific mindset, regardless of the fixed or growth mindset endorsed by individuals. It could be that critical feedback-seeking drives

individuals' variation in mindsets as well as their decision to revise, and hence improve, their posters. The path analyses we conducted next aimed to elucidate this matter.

Altogether, the findings suggest that students' domain-specific growth mindset tends to be stronger than their generic growth mindset. One mechanism that offers a possible explanation of the link between generic and domain-specific growth mindset may be that students sought critical feedback in the game to improve their poster performance, which reinforced their growth mindset regarding their abilities on the current task (i.e., poster design). Importantly, the findings show that critical feedback-seeking moderates the strength of the relation between the generic and the domain-specific growth mindsets. Specifically, of the students who endorse a strong generic growth mindset, those who seek critical feedback more often are more likely to also endorse a strong domain-specific growth mindset compared to those who seek critical feedback less often. It is important to note that critical and confirmatory feedback are complementary measures. Thus, seeking critical feedback less often is equivalent with seeking confirmatory feedback more often. However, for students who endorse a weak generic growth mindset, seeking critical feedback has a negative impact on their domain-specific growth mindset. Although students' domain-specific fixed mindset tends to be weaker than their generic fixed mindset, critical feedback-seeking behaviors did not moderate the strength of the relation between students' generic and domain-specific fixed mindset.

Path Analyses

Path analyses were conducted to examine whether revision mediates the link between critical feedback-seeking and learning outcomes, and whether mindsets moderate the link between critical feedback-seeking and learning outcomes. We first ran a path model for the generic mindsets (both fixed and growth). The result of the path model with standardized

coefficients is presented in Figure 3, with solid lines representing significant paths and dashed lines representing non-significant paths. The results indicate that the model fits the data well (χ^2 = 0.49, *df* = 1, *p* = .49, CFI = 1.00, RMSEA = .00, SRMR = .01). The unstandardized coefficients of the model depicted in Figure 3 are presented in Table 5.

First, we found a significant indirect effect of critical feedback-seeking on performance through revision (*b* = .47, *SE* = .21, 95% CI = [.073, .926], *B* = .10; 5,000 bootstrapping samples). This result indicates a full mediation, given that the total effect of critical feedback-seeking on performance is significant (*b* =1.33, *SE* = .0.35, *t* = 3.75, *B* = .27, p < .001), but the direct effect of critical feedback-seeking on performance is no longer significant when revision is included as a mediator (*b* = 0.86, *SE* = .51, *t* = 1.69, *p* = .09, *B* = .17). These findings suggest that students who sought more critical feedback performed better because they revised their work more often. This result prompts more research into the factors that lead students to revise after choosing to receive criticism. For instance, high-school students only revised essays based on constructive criticism that included the teacher's confidence in students' abilities to improve (Yeager et al., 2014). Thus, the overall results seem to suggest that it would be possible for learning behaviors (e.g., critical feedback-seeking through revision) to have an impact on the strengthening of the relation between generic and domain-specific growth mindsets, and on the corresponding weakening of the relation between generic and domain-specific fixed mindsets, as they show that learning behaviors improve performance.

Second, as shown in Figure 4, we found that generic fixed mindsets moderate the link between critical feedback-seeking and post-test learning. Specifically, a simple-slope analysis illustrated in Table 6 shows that critical feedback-seeking significantly predicts the post-test (i.e., student learning) only when students endorse a relatively weak fixed mindset (-1SD), but not

when they endorse a strong fixed mindset (+1SD). Similarly, fixed mindset negatively predicted the post-test, only when students sought critical feedback less often (-1SD), but not when they sought critical feedback more often (+1SD). In summary, as illustrated in Figure 3, students who endorsed a lower fixed mindset *and* sought critical feedback more often learned more graphic design principles; they also learned more than students who endorsed a strong fixed mindset or students who sought critical feedback less often. This result echoes other findings showing that students with lower fixed mindsets are more likely to respond positively and exert more effort after receiving critical feedback than students endorsing higher fixed mindsets (e.g., Zingoni & Byron, 2017).

A similar path model using domain-specific mindsets (both fixed and growth) was conducted. However, the results shown in Table 7 did not provide any evidence that domain-specific mindsets moderated the link between critical feedback-seeking and learning outcomes. These findings suggest that generic mindsets may be more important in predicting students' learning in the Posterlet game.

General Discussion, Conclusions, and Educational Implications

Theoretical Implications

The study contributes to previous research on mindsets in learning by comparing mindsets about general ability with domain-specific mindsets (i.e., beliefs about digital poster design). The findings support the idea that poster-design mindsets are distinct from generic mindsets, as they were only weakly associated with each other for fixed mindset. The domain-specificity of mindsets was further supported by the mean differences, such that students tend to endorse a stronger growth mindset and a weaker fixed mindset about poster design than about their general ability. This indicates that the more specific an ability is (e.g., poster design rather

than general ability), the more the students believe that they can improve. It is possible that students believe that they can find more easily effective strategies (e.g., critical feedback-seeking) to improve their specific abilities compared to strategies to improve their general ability. Moreover, the weak link between generic and specific growth mindsets (but not fixed mindsets) was moderated by critical feedback-seeking. That is, students endorsing a growth mindset are more likely to heed critical feedback and use it to strengthen their growth mindset in a particular domain. However, students' generic growth mindset was not correlated with their specific growth mindset if they sought critical feedback less often in the game. These findings further suggest that generic and domain-specific growth mindsets are distinct constructs, and their link is contingent on students' learning behaviors applied to that domain.

Moreover, we found that only generic fixed mindset predicted learning outcomes. Students who endorsed a weak fixed generic mindset learned more than those who endorsed a strong fixed generic mindset. This finding is consistent with previous studies that generic mindsets predicted learning outcomes that were domain-specific (e.g., Greene et al., 2010; Flanigan et al., 2017; Shively & Ryan, 2013). However, the present study did not find evidence to support the association of domain-specific mindsets with learning behaviors or outcomes. It is possible that domain-specific mindsets have a high-ceiling effect, such that most people believe it is likely to improve their poster-design performance with practice. Indeed, the mean domain-specific growth mindset was 9.15 out of 10. It is also possible that generic mindsets are more stable as personal traits, thus having stronger and more consistent effects on students' learning behaviors and outcomes than domain-specific mindsets (e.g., Shively & Ryan, 2013). Moreover, although fixed and growth generic mindsets were strongly correlated, only fixed generic mindsets (negatively) predicted learning outcomes. These findings are consistent across both the

bivariate correlations and the path model, suggesting that it is more important to lessen students' generic fixed mindsets rather than to increase their generic growth mindset to improve learning outcomes in this population, given that most pre-service teachers already endorse a strong generic growth mindset (8.74 out of 10) in this study.

However, findings suggest that generic fixed mindsets do not predict learning outcomes on their own. When students did not seek critical feedback to improve, endorsing any type of strong or weak fixed generic mindset did not predict their learning outcomes. Similarly, critical feedback-seeking improved learning outcomes only when students endorsed a relatively weak fixed mindset. This finding contributes to the understanding of why mindsets do not always predict learning outcomes (Sisk et al., 2018; Yeager et al., 2019). If students do not employ learning strategies to improve or do not attempt to make efforts to improve, it does not seem to matter which types of mindsets (i.e., generic or domain-specific) they endorse. In summary, fixed and growth mindsets, as well as generic and domain-specific mindsets, may exhibit different mechanisms in relation to learning processes. Generic mindsets, and specifically fixed generic mindsets, predict learning outcomes and moderate the link between critical feedback-seeking and learning outcomes, whereas domain-specific mindsets do not seem to predict any learning outcomes. Thus, the findings of this study have implications for teaching and learning, as understanding the experiences that generate shifts in mindset will help design curricula that optimize students' learning experiences and outcomes.

Practical Implications

The findings of this study suggest that teachers can lessen students' fixed mindsets before learning occurs, which may encourage students to learn more from critical feedback via revising their work. As the current study found that mindsets predict learning outcomes only when

students seek critical feedback more often, teachers may consider cultivating environments that encourage critical feedback-seeking to help students improve their learning outcomes. Importantly, this research found that generic rather than domain-specific mindsets are linked to learning outcomes. Thus, teachers may work on lessening students' general fixed mindsets rather than working on improving their domain-specific mindsets (e.g., regarding their poster design ability). In turn, students with lower generic fixed mindsets may make use of critical feedback information more effectively to improve their learning outcomes. For example, research shows that mindset interventions can reduce students' fixed mindsets, which can in turn influence their self-regulation, causal attributions, and self-regulated behavior that are important for learning (e.g., Blackwell, Trzesniewski, & Dweck, 2007). Reducing students' fixed mindsets is particularly important because many studies have shown that students' fixed mindsets tend to increase over time with no intervention (Dai & Cromley, 2014) and this increase is associated with lower achievement (Shively & Ryan, 2013).

Although the current study reveals that generic growth mindsets did not predict learning outcomes, generic growth mindsets were found to be strongly related to generic fixed mindsets. Thus, teachers can also encourage students to endorse a generic growth mindset to counteract students' fixed mindsets. Based on the current results, generic growth mindset may also spill over to their mindsets about learning graphic design principles, especially for students who seek critical feedback more often. Previous research also showed that interventions about individuals' general abilities can enhance students' growth mindset about their math ability, which in turn can influence their performance in math (Good, Aronson, & Inzlicht, 2003). As such, some students may become motivated to expand their general ability, and this motivation may drive them to learn and to endorse growth mindsets in other domains (Shively & Ryan, 2013).

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Tables

Table 1

The generic mindset questionnaire.

Item	How much do you agree with the following statements? (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)
1	You cannot really change your abilities.
2	You can always change your abilities.
3	You can learn new things, but you cannot really change your abilities.
4	You can get better with practice.

Note. Items 1 and 3 represent fixed mindset items, while items 2 and 4 represent growth mindset items.

Table 2

The specific mindset questionnaire.

Item	How much do you agree with the following statements? (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)
1	You cannot really change your abilities to design posters.
2	You can always change your abilities to design posters.
3	You can learn new things, but you cannot really change your ability to design posters.
4	You can get better at designing posters with practice.

Note. Items 1 and 3 represent fixed mindset items, while items 2 and 4 represent growth mindset items.

Table 3

Bivariate Correlations and Descriptive Statistics: Mean (M), Standard Deviation (SD), Skewness, and Kurtosis.

	2	3	4	5	6	7	8	9	10
1. Gender	.02	.16	-.09	.09	-.13	-.20*	-.17	.02	-.16
2. Generic fixed mindset		.24*	-.74***	-.12	-.07	-.06	-.09	-.21*	-.09
3. Specific fixed mindset			-.26**	-.54***	-.06	-.12	-.07	.06	.00
4. Generic growth mindset				.19	.08	.12	.07	.10	.02
5. Specific growth mindset					.10	.00	-.07	-.09	-.09
6. Pre-test						.11	-.05	.43***	.61***
7. Feedback-seeking							.53***	.19	.26**
8. Revision								.12	.24*
9. Post-test									.26**
10. Performance									--
N	107	100	107	100	107	107	107	100	107

Mean	3.72	3.23	8.74	9.15	12.06	5.49	1.34	2.16	41.69
SD	1.45	1.32	1.26	1.08	4.07	1.92	1.20	0.95	9.42
Range	2-10	2-7	2-10	5-10	-4-20	0-9	0-3	0-4	0-58
25th	2	2	8	8	10	4	0	2	38
50th	4	3	9	10	12	5	1	2	43
75th	4	4	10	10	16	7	2	3	49
Skewness	.98	.92	-1.99	-1.30	-.84	-.04	.16	-.18	-1.46
Kurtosis	2.24	.39	7.21	1.73	1.59	-.63	-1.53	-.04	3.60

Note: $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$, two-tailed Spearman correlations.

Table 4

Within-subjects t-test

Difference score	*r*	*Difference (SD)*	*t*	*Cohen's d*
Specific - Generic growth mindset	.23*	.36 (1.36)	2.24***	.28
Specific - Generic fixed mindset	.23*	-.44 (1.58)	-2.37***	.29

Note. ***$p < .001$; *$p < .05$

Table 5
Maximum Likelihood Estimates for the Final SEM Model on Performance and Post-test (controlling for the pre-test). Exploring the interactions between critical feedback-seeking and generic mindset on two learning outcomes.

Outcome variable	Predictor	*b*	*S.E.*	*t*	*p*	R^2
						.28***
Revision	Feedback-Seeking	0.33	0.05	6.88	**<.001**	
	Generic Growth Mindset	-0.09	0.13	-0.67	0.51	
	Generic Fixed Mindset	-0.09	0.10	-0.93	0.35	
	Feedback-Seeking × Generic Growth Mindset	-0.01	0.06	-0.18	0.85	
	Feedback-Seeking × Generic Fixed Mindset	0.00	0.05	0.05	0.96	
Performance						**.49*****
	Revision	1.43	0.63	2.25	**0.02**	
	Feedback-Seeking	0.86	0.51	1.69	0.09	
	Generic Growth Mindset	-1.40	0.91	-1.55	0.12	
	Generic Fixed Mindset	-0.90	0.72	-1.25	0.21	
	Feedback-Seeking × Generic Growth Mindset	-0.03	0.44	-0.06	0.95	
	Feedback-Seeking × Generic Fixed Mindset	0.26	0.37	0.69	0.49	
	Pre-test	1.43	0.17	8.34	**<.001**	

Post-test					**.33****
	Revision	0.02	0.09	0.21	0.83
	Feedback-Seeking	0.10	0.05	2.01	0.04
	Generic Growth Mindset	-0.11	0.09	-1.26	0.21
	Generic Fixed Mindset	-0.21	0.08	-2.56	**0.01**
	Feedback-Seeking × Generic Growth Mindset	-0.04	0.05	-0.82	0.42
	Feedback-Seeking × Generic Fixed Mindset	-0.09	0.04	-2.52	**0.01**
	Pre-test	0.11	0.02	5.26	**<.001**

Note. b = unstandardized path coefficient. The scores for feedback-seeking, fixed mindsets, and growth mindsets are mean centered.

Table 6
Simple Slopes Analyses for Predictors on Post-test Learning at ±1SD of the Moderator.

Predictor	Level of moderator	*b*	*SE*	*t*	*p*
Generic Fixed Mindset	Feedback-Seeking (–1*SD*)	–.03	.10	–0.32	.756
	Feedback-Seeking (+1*SD*)	**–.29**	**.10**	**–2.76**	**.001**
Feedback-Seeking	**Generic Fixed Mindset (–1*SD*)**	**.19**	**.07**	**2.60**	**.011**
	Generic Fixed Mindset (+1*SD*)	.01	.07	0.18	.858

Note. The pre-test is controlled in the analysis.

Table 7
Maximum Likelihood Estimates for the Final SEM Model on Performance and Post-test (controlling for the pre-test). Exploring the interactions between critical feedback-seeking and domain-specific mindsets on two learning outcomes.

Outcome variable	Predictor	*b*	*S.E.*	*t*	*p*	R^2
						.28***
Revision	Feedback-Seeking	0.36	0.06	6.59	**<.001**	
	Specific Growth Mindset	-0.10	0.13	-0.78	0.43	
	Specific Fixed Mindset	-0.06	0.11	-0.53	0.60	
	Feedback-Seeking × Specific Growth Mindset	-0.09	0.06	-1.51	0.13	
	Feedback-Seeking × Specific Fixed Mindset	0.01	0.06	0.14	0.89	
Performance						**.49*****
	Revision	1.53	0.68	2.26	**0.02**	
	Feedback-Seeking	0.68	0.50	1.35	0.18	
	Specific Growth Mindset	-1.32	0.77	-1.73	0.09	
	Specific Fixed Mindset	-0.08	0.53	-0.15	0.88	
	Feedback-Seeking × Specific Growth Mindset	0.42	0.45	0.92	0.36	
	Feedback-Seeking × Specific Fixed Mindset	-0.30	0.30	-1.01	0.32	

	Pre-test	1.41	0.22	6.47	**<.001**	
Post-test						**.33****
	Revision	0.04	0.09	0.37	0.71	
	Feedback-Seeking	0.10	0.05	1.88	0.06	
	Specific Growth Mindset	-0.09	0.15	-0.61	0.54	
	Specific Fixed Mindset	0.04	0.12	0.32	0.75	
	Feedback-Seeking × Specific Growth Mindset	0.05	0.08	0.63	0.53	
	Feedback-Seeking × Specific Fixed Mindset	0.07	0.05	1.32	0.19	
	Pre-test	0.11	0.02	5.29	**<.001**	

Note. b = unstandardized path coefficient. The scores for feedback-seeking, fixed mindsets, and growth mindsets are mean-centered.

Figures

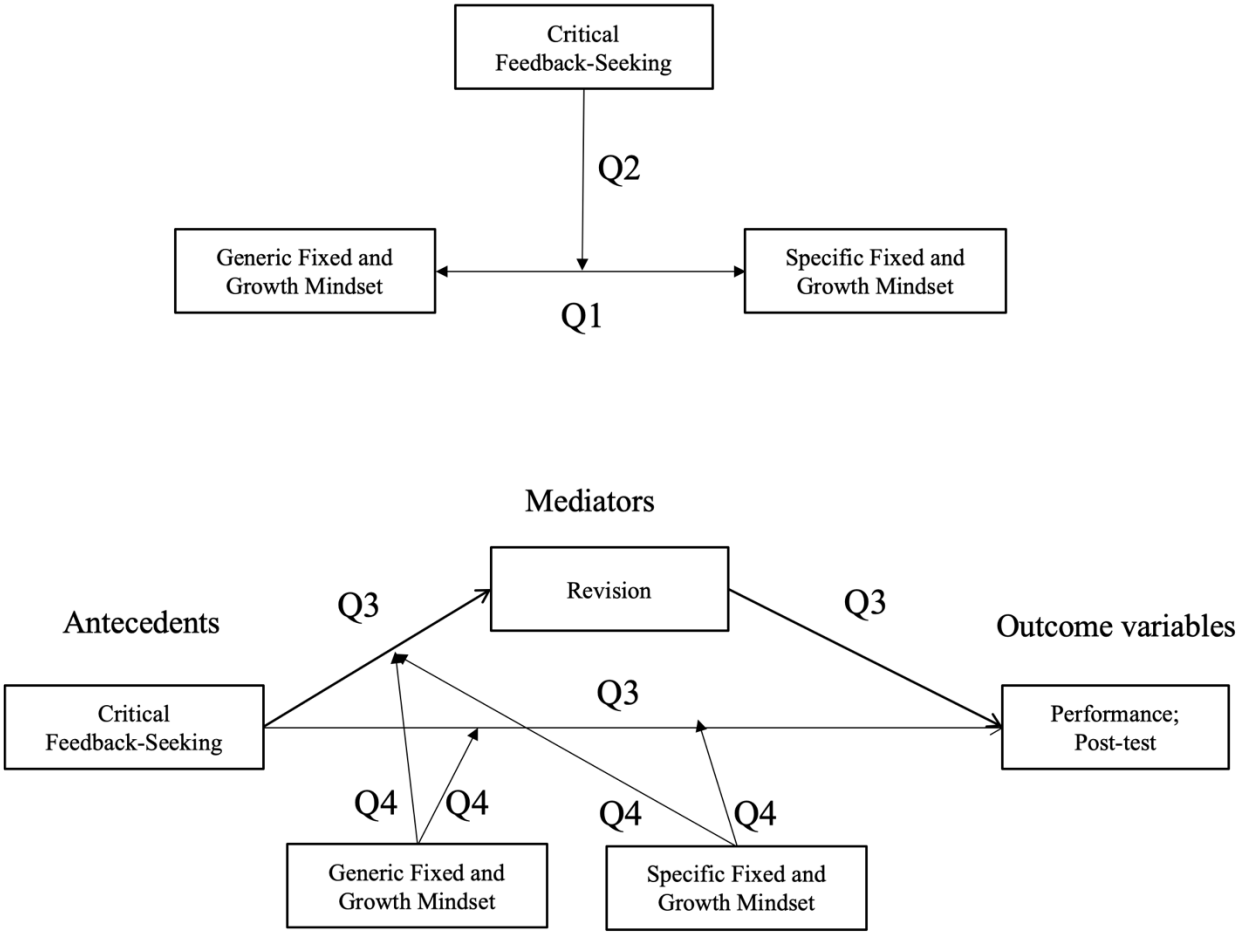

Figure 1. Research questions and the theoretical model.

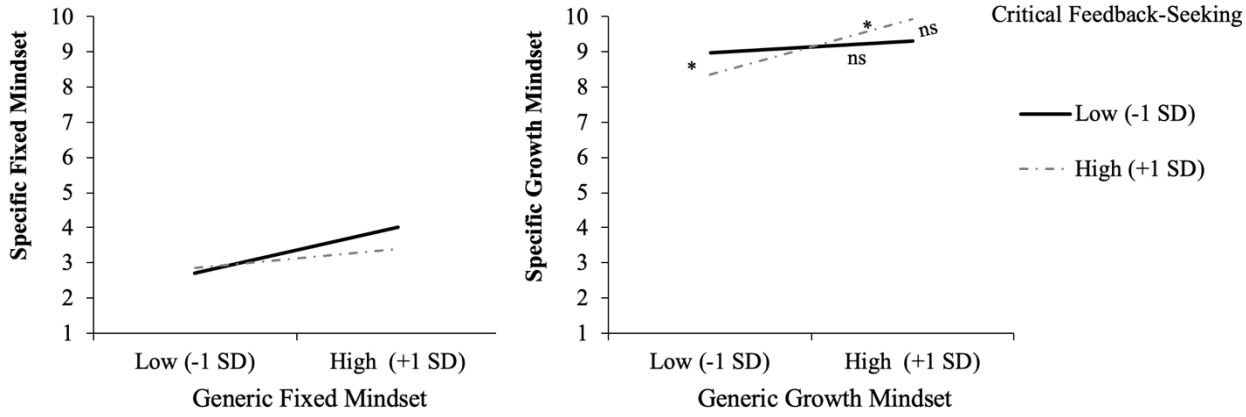

Figure 2. Critical feedback-seeking moderates the relation between generic and specific growth mindset: the higher the generic mindset, the higher the domain-specific growth mindset, but only for those who choose critical feedback-seeking more often in the game. Thus, there is no significant difference between growth mindset types (generic versus domain-specific) when students choose lower amounts of critical feedback. Results were not replicated for fixed mindset.

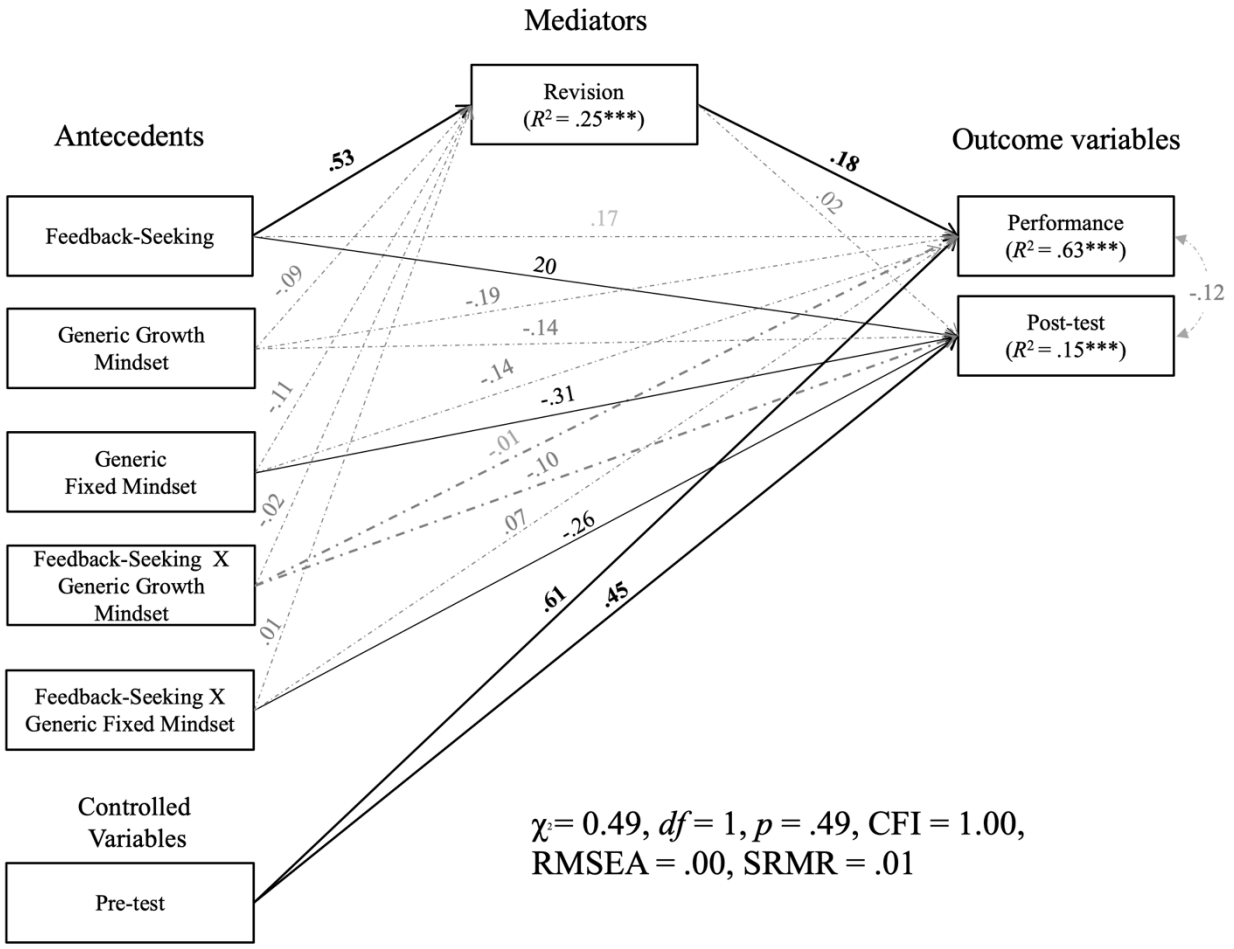

Figure 3. Path analysis model (n = 107). The findings show that revision fully mediates the relation between critical feedback-seeking and performance. Critical feedback-seeking directly predicted learning (i.e., the post-test), but this relation was moderated by generic fixed mindset.

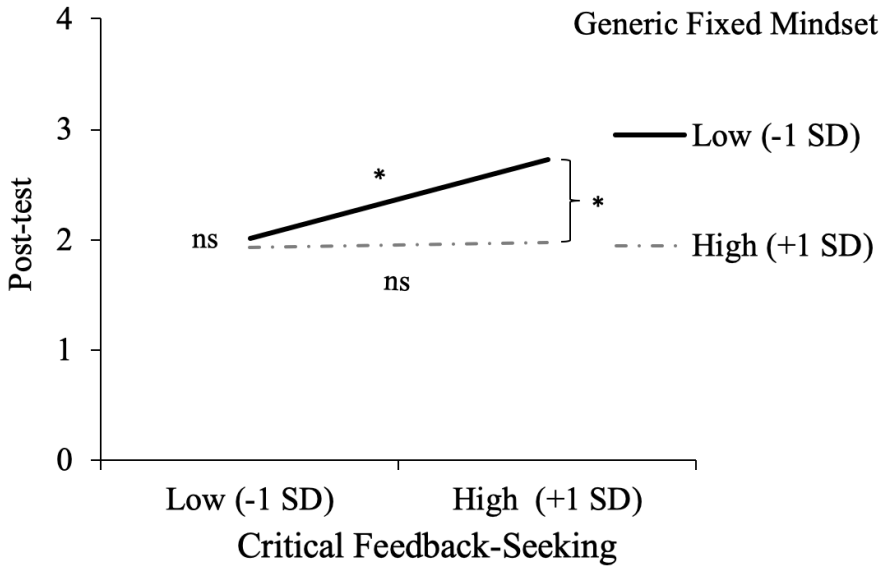

Figure 4. The visualization of the simple-slopes analysis (n = 107). Generic fixed mindset moderates the relationship between critical feedback-seeking and post-test learning. Students who endorse a weaker fixed mindset (represented by the solid black line) learn significantly more graphic design principles when they choose higher rather than lower amounts of critical feedback. Concomitantly, students who endorse a stronger fixed mindset (represented by the dashed grey line) learn at the same rate regardless of the amount of critical feedback they choose. That is, those who seek more feedback and endorse a weaker fixed mindset learn more.