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How Can We Reap Learning Benefits for Individuals With Growth and Fixed Mindsets?: Understanding Self-Reflection and Self-Compassion as the Psychological Pathways to Maximize Positive Learning Outcomes

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Having a growth mindset has been hailed as one of the most critical advancements in understanding students' motivation in recent years. The attention on the growth mindset indicates an increased surge in the public's interest in using evidence-based intervention models to facilitate learning. Because the positive benefits of growth mindsets are apparent, changing ones' mindset becomes the core focus of growth mindset literature. But aside from "changing" students' mindsets, finding the right kind of psychological interventions that leverage student's growth or fixed mindset with sustainable improvement for students can be as, if not more important. The current study seeks to fill this research gap. Our first study indicated that learners with a relatively high growth mindset benefit from a self-reflection learning strategy. However, this very same self-reflection strategy can harm the learning benefits for those learners with a fixed mindset. The second study used experimental manipulation to show that learners with a growth mindset can enhance their learning process and outcomes from self-reflection strategies. In contrast, learners with a fixed mindset can improve their learning process and result from self-compassion strategies. The current study identified two distinct psychological mechanisms – self-reflection and self-compassion and linked them with mindsets with the learning process and learning outcomes. It also demonstrates how learners with growth and fixed mindsets can directly benefit from these two psychological mechanisms in an experimental design.

Keywords: growth mindset, fixed mindset, self-compassion, self-reflection, mindset, positive learning outcomes

INTRODUCTION

Having a growth mindset has been hailed by many as one of the most important advancements in understanding students' motivation in recent years (Dweck, 1999). These accolades perhaps reflect the increasing attention educators, parents, and policyholders pay to use evidence-based intervention models to facilitate learning. The growth mindset believes that humans can appraise

their abilities under the different frames of mind (Dweck, 2007). When learners believe that their abilities are malleable and can grow, they often exhibit higher learning performance (DWECK, 2006; Boyd, 2014) and improve their psychological well-being (Zeng et al., 2016). On the contrary, when learners believe their abilities to be fixed, they often find it difficult to deal with challenges and setbacks (Dweck and Master, 2009).

Past studies have shown that students' motivation to learn, perseverance in challenges, and attitudes toward failures improve positively after mindset training (Dweck, 1999, 2007, 2010; Duckworth et al., 2007). Besides direct learning outcomes, learners with a growth mindset are often more socially connected to others and hold higher meaning in life than those with a relatively fixed mindset (Yeager et al., 2016). Large-scale studies conducted outside of the US support that having a growth mindset can reliably buffer the effect of poverty on future achievement (Claro et al., 2016). These studies attest to the importance of having a growth mindset (or not having a fixed mindset) when we approach learning.

Due to the positive effect of having a growth mindset, changing students' mindset became the core goal of many research paradigms on this topic (Grant and Dweck, 2003; Blackwell et al., 2007; King, 2012; Paunesku et al., 2015; Yeager et al., 2016). Alternatively to changing a student's mindset, another approach is to leverage on student's existing mindset to promote positive learning outcomes. Specifically, while the changing of ones' mindset is the core focus of growth mindset literature, how to efficiently strengthen the positive effect of growth mindset or weaken the negative impact of fixed mindset on learning outcomes was not systematically explored in past research. Aside from improving or changing student's mindset, finding the right kind of psychological interventions that leverage on student's growth or fixed mindset with sustainable improvement for students can be as important (Wilson, 2002; Yeager and Walton, 2011; Cohen and Sherman, 2014; Walton, 2014).

Therefore, interventions can potentially lead to more harm than good without knowing the psychological underpinning on improving learning outcomes for learners with a growth mindset or impeding the negative effect from a fixed mindset. The current study seeks to fill this research gap by identifying the psychological mechanisms that promote (inhibit) growth (fixed) mindsets on having positive learning and psychological outcomes. Because growth and fixed mindset has often been portrayed as a single construct in past studies, intervention on enhancing growth mindset was often assumed to lead to a decrement of a fixed mindset. However, at the same time, researchers have also shown that the antecedents and consequences in handling the tasks at hand differed drastically for students who have the growth versus the fixed mindset. Specifically, past studies have shown that students who have a fixed mindset are much more likely to focus on success or failure before anticipating a task and have difficulty dealing with failures when it occurs. On the contrary, students who have the growth mindset are more likely to continuously appraise their ability and accommodate and learn and are much more likely to accept failure when it occurs (Dweck, 2007; Reardon, 2011). Based on these past findings, it is likely that separate psychological mechanisms could govern growth and fixed mindset. While improving the growth mindset can inevitably enhance students' performance. Nonetheless, it is theoretically and practically important to see whether we can test the psychological mechanisms that governed the two routes of mindsets.

In the current study, we propose that different strategies should be used to promote positive outcomes for people having a growth or fixed mindset. Mapping on past findings on self-appraisal as the antecedent for having a growth mindset, and self-blame for having a high fixed mindset, we proposed two psychological strategies that would enable learners with the two different mindsets to improve their performances. Specifically, we propose that those who have a growth mindset learn better and have better psychological well-being when performing ***self-reflection*** during their learning trials. At the same time, fixed mindset learners perform better and have better psychological well-being when they perform ***self-compassion*** during their learning trials. Moreover, a mismatch on learning strategies with ones' mindset can harm the learning process and outcomes. We will review the pertinent literature before introducing our current studies.

The two studies in this paper confirm the past findings that a fixed mindset hurts the learning process and outcome, while a growth mindset positively enhances the learning process and outcome. However, most importantly, we will demonstrate that the two distinct psychological mechanisms, namely performing the self-reflection or the self-compassion practice, can inhibit or promote learning process and outcomes depending on whether they were applied to learners with a growth or fixed mindset when appropriate (matched) psychological mechanism is used (specifically, self-compassion for learners with a fixed mindset and self-reflection for learners with a growth mindset), the negative effect of a fixed mindset can be attenuated. Using the mismatched method can decrease the learning process and outcome even for learners with a growth mindset.

Implicit Theories on Learning Behaviors

Carol Dweck, who championed the movement on using implicit theories or mindsets to understand learning in educational settings, referred to the growth mindsets as "the beliefs about the capacity to grow one's abilities" (Haimovitz and Dweck, 2017). Specifically, people with a growth mindset believe that their abilities are malleable and can change with time and effort; on the contrary, people with a fixed mindset believe that their abilities are fixed and cannot be changed with time effort. There is mounting evidence that a growth mindset can significantly impact learning motivations, learning behaviors, and learning outcomes (DeBacker et al., 2018; Huang et al., 2019; Smith and Capuzzi, 2019). For example, in a study that seeks to understand the effect of growth mindset has on academic performance, researchers found that students who had received growth mindset training are more persistent and motivated in completing the algebra exercise and have better performance compared with the control group who had no growth mindset training (Bettinger et al., 2017). Dweck (2007) asserted that learners change their way of appraising their abilities when they believe they are

malleable and can change over time (growth mindset). Instead of considering their abilities as an in-born characteristic, they link them to hard work and perseverance. Challenges are seen as an opportunity to grow for individuals with growth mindsets, whereas for individuals with fixed mindsets, challenges can induce worries about failures and setbacks (Dweck, 2007; Reardon, 2011).

Psychological Underpinnings for Growth Mindset

Due to the positive benefits of a growth mindset, Educators and researchers began to find ways to instill a growth mindset in students and have assumed that students were socialized to have a growth mindset. Some studies have linked parents' growth mindset to their child (Stipek et al., 2001; Moorman and Pomerantz, 2010; Rattan et al., 2012a,b; Muenks et al., 2015). A study that examined reading and writing skills for 1587 second graders found that parents who received the growth mindset training improved their children's reading and writing abilities. This effect persisted even after controlling for their socioeconomic status and became even more profound when the parents had a fixed mindset before the intervention (Andersen and Nielsen, 2016). Past research has also linked teachers' socialization with students' growth mindset. For example, students who were taught the growth mindset and perseverance by their teachers showed higher performance outcomes and better psychological well-being when they faced adversity (Hochanadel and Finamore, 2015; Duckworth, 2016).

However, the results on mindsets transmission are not all consistent. Past studies have also shown that growth mindset teaching can be ineffective; in many instances, researchers could only find minimal or indirect effects between teacher's and student's mindset correlation (Zeng et al., 2019). Direct socialization does not always work because teachers cannot deliver the feedback correctly at the right time (Miller, 2019). Moreover, the perception of failure and success can be arbitrary. Teachers' individual characteristics (such as their motivation, emotions, mindset, and temperament) can also affect the effectiveness of mindset socialization (Dweck, 2016). Moreover, learners' can also have different perceptions toward person vs. process praise. Past studies found that when learners felt the recognition was not genuine or felt teachers were extolling unreasonable demands, they were less likely to have learning improvement or mindset changes (Seaton, 2018). In sum, research evidence from past studies indicated clear benefits to having a growth mindset. The benefits include having a higher level of self-esteem, being more likely to display positive affect, and having better interpersonal relationships with peers. Past studies also supported that learners with a fixed mindset were more likely to exhibit a higher level of anger, anxiety, shame, boredom, and hopelessness (King et al., 2012). Based on the above evidence, learners with a growth mindset can excel because they can better focus on their learning process. In contrast, students with fixed mindsets were comparatively less likely to succeed due to the fear of negative feedback or failure. While it is apparent that the determinants for success and failure were different between individuals with a growth or fixed mindset, past research has often used a one size fits all methodology to improve the learning outcomes for individuals with a growth (fixed) mindset. This approach has disregarded the possible differences in psychological mechanisms responsible for the success in growth mindset or the failure that fixed mindset individual experienced. The lack of differentiation possibly contributed to why mindset changes were often ineffective or non-sustainable for learners. The current study seeks to fill this research gap. We propose that different psychological mechanisms are responsible for improving the positive benefits one can reap from having a growth mindset and impeding the negative benefits for learners with a fixed mindset.

Specifically, because learners with a growth mindset are more inclined to focus on the process of learning and the mastery of the task at hand, these learners will benefit from strategies that help them to assess their abilities accurately. On the contrary, learners with a fixed mindset often have difficulty dealing with their fear of failure; hence, to enhance learners' performance and psychological well-being with a fixed mindset, one should focus on eliminating such fear by taking a non-judgmental attitude toward their inadequacies. Based on the above, the current paper argues that (a) different psychological mechanisms governed the improvement of the learning process and outcomes for learners with a growth mindset and learners with a fixed mindset, and (b) self-reflection is an important mechanism to facilitate the improvement (performance and learning process) for learners with a growth mindset while self-compassion is an important mechanism to facilitate the improvement (performance and learning process) for learners with a fixed mindset.

Self-Reflection and Self-Compassion on Growth Versus Fixed Mindsets Learners

Self-reflection is defined as our ability to cognitively appraise the situation (Bandura, 2001; Gross and John, 2003) and make behavioral modifications based on our appraisals to obtain our desired goals (Gross, 1998). In the process of self-reflection, one would often take an objective look at ourselves and subsequently identify and evaluate one's thoughts, emotions, and actions (Grant, 2001). Self-reflection is said to be the basis for self-regulation (see Social Cognitive Theory; Bandura, 2001) and is positively correlated to self-efficacy (van Seggelen-Damen and van Dam, 2016).

In the context of learning, self-reflection is effective in increasing one's motivation toward achieving our learning goals (Norrish, 2015; Travers et al., 2015; King et al., 2016). Most likely because honest self-reflection facilitates more objective retrospection into one's achievements and shortcomings in previous activities. The insight regarding one's positive accomplishments fuels a sense of competence, motivating them to devote an increasing effort to the task. The reflective processes can also generate insights regarding one's weaknesses, revealing a clear picture of subsequent actions needed to achieve the goal. In other words, self-reflection allows us to critically review its steps to achieve our goals. Yet, self-reflection is not always beneficial in the learning process. Past studies have also shown

that self-reflection can lead to ruminative thoughts if learners are stuck in the process of self-criticism (Grant, 2001; Silvia and Phillips, 2011; Cowden and Meyer-Weitz, 2016). Such ruminative behaviors can damage the learning process because they can halt the learners from further engagement with the task, especially when they perceive their abilities cannot be improved. These findings support our argument that self-reflection is only helpful to drive performance and a positive learning process when the learner possesses a growth mindset. Because rumination in self-reflection can potentially lead to self-blame, which learners with a fixed mindset are already prone to suffer when encountering failure, self-reflection would not be an appropriate strategy to improve the learning process and outcomes for learners with a fixed mindset.

Another line of research on self-compassion points to its apparent benefits in promoting psychological well-being (Breines and Chen, 2012). According to Neff (2003), self-compassion involves being mindful and non-judgmental toward one's inadequacies and failures (mindfulness), acknowledging one's experience as a part of the common human experience (common humanity), and maintaining a kind and caring attitude toward oneself (self-kindness). Self-compassion can buffer negative self-feelings, specifically when they encounter stress and ambivalent feedback in social settings (Cunha et al., 2016). Because self-compassion was found to promote self-regulation, individuals who practice self-compassion are less prone to emotional fluctuations and show less self-blaming behaviors (Terry and Leary, 2011). In the application for learners, boosting one's self-compassion was found to be more effective than self-esteem to increase the self-improvement motivation, demonstrated by a higher reported eagerness to change one's weakness and increased time to study for a difficult test after an initial failure (Breines and Chen, 2012). The above helps students combat self-handicapping behavior when completing learning tasks (Leary et al., 2007; Petersen, 2014). Self-compassion works because it blocks the direct link between failure and self-inadequacies, reducing the negative impact of failing. Moreover, individuals who engage in self-compassion acts are more likely to accept failure as part of their regularities. The self-compassion literature provided strong evidence that self-compassion practices could attenuate the negative effect of a fixed mindset during the learning trials. Because the nature of self-compassion can potentially diminish ones' motivation to self-appraise after failure, core qualities in learners with a growth mindset, self-compassion, would not be an appropriate strategy to improve learning outcomes or processes for learners with a growth mindset. The current study attests that growth and fixed mindset are not always the flip side of the same coin. While self-reflection can enhance the learning outcomes for learners with a growth mindset, self-compassion can improve the learning outcomes for learners with a fixed mindset. We test this framework in a survey design in Study 1 and an experimental study design in Study 2. Our hypotheses are as follows:

H1a: Participants' fixed mindset positively affects their performance goals.
H1b: Participants' growth mindset positively affects their mastery goal.
H2a: There is an interaction effect between participants' fixed mindset and their self-reflection/compassion on their performance goal.
H2b: There is an interaction effect between participants' growth mindset and their self-reflection/compassion on their mastery goal.
H3a: There is an interaction effect between participants' fixed mindset and their self-reflection on their fear of negative evaluation.
H3b: There is an interaction effect between participants' growth mindset and their self-reflection on their fear of negative evaluation.
H4a: There is an interaction effect between participants' growth mindset and their self-reflection on their performance outcomes.
H4b: There is an interaction effect between participants' fixed mindset and self-compassion on their performance outcomes.

STUDY 1

To understand our hypotheses, we first explore whether a growth (fixed) mindset is beneficial for learning experiences in our current sample. Second, we test whether self-reflection (self-compassion) can interact with a learner's growth (fixed) mindset. We predict that learners with a growth mindset will benefit from using a self-reflection strategy to enhance their learning outcomes further. On the contrary, learners with a fixed mindset will benefit from using a self-compassion strategy to mitigate their responses to failure during their learning trials. Furthermore, we hypothesize that when the self-reflection (self-compassion) strategy is utilized by a fixed (growth) mindset learner respectively, learning outcomes will decrease. Therefore, in our first study, we will measure participants' growth and fixed mindsets, their self-reflection tendency, their self-compassion tendency, as predictor variables, and learning outcomes and fear of negative evaluations as dependent variables.

Method

Participants

We recruited 88 participants from a major public University (51.1% female, mean age = 24, see **Table 1**), all reported to be full-time undergraduate students currently enrolled in the semester that they participated in the study.

Procedure

Participants were recruited and told to complete a questionnaire related to their past learning experiences. Participants were informed about the minimal risk of the Study, and all of the participants gave their consent to participate. They were given an hour to complete, and all of the participants finished within 45 min. They were asked to turn off their cell phone for the study duration, and the experimenter has not recorded any abnormalities during the Study. Participants were debriefed and provided contact of the ethics committee and the primary investigator should they have future questions.

TABLE 1 | Demographic information.

	Study 1 (*N* = 88)	Study 2 (*N* = 99)
Characteristic	**% of respondents**	**% of respondents**
Sex		
Female	51.1	76.8
Male	48.9	23.2
Age		
<18	2.3	82.8
18–24	51.1	17.2
25–34	43.2	0
35–44	2.3	0
45–54	1.1	0
Education		
Primary	1.1	0
Secondary	1.1	3
Non-degree tertiary	4.5	1
Degree	67	78.8
Master or above	26.1	17.2

Measures

First, participants filled out the revised implicit theories of intelligence scale to measure their growth and fixed mindset. The scale contains eight items on a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree). Sample items include, "Regardless of my current intelligence level, I think I can change it quite a bit" for growth mindset, and "My intelligence is something about me that I personally can't change very much." for fixed mindset (De Castella and Byrne, 2015) ($\omega = 0.90$ for growth-mindset and $\omega = 0.89$ for fixed mindset).

We adopted the self-reflection and insight scale (Grant et al., 2002) to measure participants' tendency to engage in self-reflection and the self-compassion scale (Neff, 2003) to measure participants' self-compassion tendency. The self-reflection and insight scale consists of 20 items and is commonly used to measure whether individuals have a high versus low inclination to engage in self-reflection. Sample item includes "I frequently take time to reflect on my thoughts" (Grant et al., 2002, $\omega = 0.86$). The self-compassion scale is a twelve items scale that was being used to measure ones' self-compassion inclination; the sample item includes "I try to see my failings as part of the human condition" (Neff, 2003; $\omega = 0.80$).

Study 1 research design does not allow us to test our participant's actual learning outcomes directly. Therefore, as a proxy for learning outcomes, we adopted the standardized scale of learning goal orientation. Learning goal orientation is detrimental to learning success, and numerous studies have documented the positive relationship between learning orientation and actual performance outcomes (Button et al., 1996, $\omega = 0.80$ for mastery goal and 0.78 for performance goal). There are two dimensions of learning orientation: mastery and performance goals. Individuals with performance goals are often more concerned with proving their competence, while individuals with mastery goals are more concerned with increasing one's competence on the task. Past studies have shown that students with a growth mindset are more likely to be linked with mastery goals, while students with a fixed mindset are more likely to be connected with performance goals. A sample item includes, "When I fail to complete a difficult task, I plan to try harder the next time I work on it" (mastery goal), and "I feel smart when I can do something better than most other people" (performance goal). We are interested to understand whether a growth (fixed) mindset interacts with self-reflection (self-compassion) strategies on their learning orientations (mastery and performance goals).

Past literature has concluded that learners with a fixed mindset were more likely to fail because they had difficulty dealing with failure and criticisms. Therefore, brief fear of negative evaluation scale was used to measure participants' level of anxiety when facing criticism (Leary, 1983). The scale includes 12 items, and a sample item has "I am afraid others will not approve of me" ($\omega = 0.93$).

Analysis Strategies

The Mean, Standard Deviation, Pearson bivariate correlation analyses, confirmatory factorial analyses, and multiple regression analyses were performed in this research. Given the increasing critical comments regarding Cronbach's alpha as an internal consistency measure, we have adopted to use the McDonald's Omega (McNeish, 2018) to document the internal consistency of our scale in this paper. Analyses were conducted using SPSS Version 24 and R software 4.1.1. We used the statistical software R and SPSS as our primary analytical instruments to further understand our hypotheses. We ran the confirmatory factor analysis using the lavaan package in R and used SPSS for descriptive, regression models, and correlational models, the specifics of our analytical procedures are explained within the results section.

Results

We calculated all the scores for growth mindset, fixed mindset, self-compassion, self-reflection, performance orientation, and learning orientation using the respective scale by aggregating the scores in the respective scales and mean-cantering them. Before exploring our research model, we first submitted the model to the CFA using R software. Fit indices showed overall good fit of the data to the seven-factor model (i.e., mastery goal, performance goal, fixed mindset, growth mindset, self-reflection, self-compassion, and fear of negative evaluation; RMSEA = 0.082, CFI = 0.91; TLI = 0.89), when compare to the four-factor model (combined mastery goal and performance goal, fixed mindset and growth mindset, and self-reflection and self-compassion; RMSEA = 0.134, CFI = 0.74; TLI = 0.70) and single-factor model (combined all factors; RMSEA = 0.210, CFI = 0.33; TLI = 0.25). The fit analysis supports our rationale to explore these variables separately.

Correlation analyses were performed on the above variables to explore the relationship among participants' mindset, learning goal orientation, self-reflection, and self-compassion (**Table 2**). We found that fixed mindset has a negative relationship with mastery goal ($r = -0.28^{**}$), while growth mindset has a positive relationship with mastery goal ($r = 0.35^{**}$). Self-compassion and

TABLE 2 | Correlations for Study 1 (N = 88).

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
(1) Gender	1.49	0.5									
(2) Age	2.49	0.64	–0.25*								
(3) Education	4.16	0.66	–0.17	0.33**							
(4) Fixed Mindset	3.06	1.08	–0.29**	0.16	0.09						
(5) Growth Mindset	4.28	0.94	0.32**	–0.09	–0.03	–0.77**					
(6) Self-Reflection	3.56	0.46	–0.16	0.07	0.27*	–0.01	0.04				
(7) Self-Compassion	3.06	0.58	0.1	0.04	–0.06	–0.12	0.17	0.31**			
(8) Performance Goal	4.69	0.63	0.1	0.12	0.01	0.17	–0.03	–0.02	–0.11		
(9) Mastery Goal	4.82	0.53	0.06	0.01	0.1	–0.28**	0.35**	0.31**	0.24*	–0.1	
(10) Fear of Negative Evaluation	3.37	0.81	–0.21	0.05	0.09	0.04	–0.04	–0.14	–0.47**	0.29**	–0.03

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Two-tailed.*

TABLE 3 | Regression for Study 1 (N = 88).

	Performance goal				Mastery goal				Fear of negative evaluation			
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**
Intercept	4.7	4.7	4.7	4.71	4.82	4.82	4.82	4.82	3.37	3.37	3.37	3.37
Gender	0.1	0.12	0.11	0.11	0.05	–0.01	–0.01	–0.02	–0.13	–0.15	–0.17*	–0.19*
Age	0.11	0.1	0.09	0.09	–0.01	–0.01	–0.01	–0.01	0.02	0.02	–0.01	–0.01
Education	–0.03	–0.04	–0.04	–0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.04
Self-reflection (SR)	0.04	0.04	0.05	0.05	0.14*	0.13*	0.14*	0.13*	–0.03	–0.04	–0.02	–0.04
Self-compassion (SC)	–0.1	–0.1	–0.09	–0.09	0.08	0.06	0.07	0.07	–0.36**	–0.37**	–0.34**	–0.34**
Fixed mindset		0.23*	0.21*	0.21*		–0.03	–0.05	–0.04		–0.01	–0.06	–0.03
Growth Mindset		0.14	0.12	0.11		0.15+	0.15	0.15		0.08	0.08	0.1
Fixed mindset × SR			0.02				0.06				0.21*	
Fixed mindset × SC			0.03				–0.01				–0.02	
Growth mindset × SR				–0.01				–0.06				–0.19*
Growth mindset × SC				–0.07				0.01				0.02
R^2	0.05	0.11	0.11	0.12	0.13	0.22	0.24	0.24	0.25	0.26	0.32	0.31
ΔR^2		0.06	0.06	0.07			0.11*	0.11**		0.01**	0.07**	0.06**

*+$p < 0.10$; *$p < 0.05$; **$p < 0.01$.*

self-reflection positively correlate with mastery goals (r = 0.24* and r = 0.31**), respectively.

We controlled participants' gender, age, and education level in the regression analysis. The results in **Table 3** show that participants' fixed mindset positively affects their performance goal (b = 0.23, p = 0.036, 95%CI = [0.015,0.440], M2 of **Table 3**). In contrast, participants' growth mindset positively impacts their mastery goal (b = 0.15, p = 0.086, 95%CI = [–0.021,0.316], M6 of **Table 3**), supporting our H1a and H1b. However, there is no interaction effect between participants' mindset and self-reflection/compassion on their learning goal orientations. Thus, H2a and H2b are not supported.

Consistent with our hypothesis (i.e., H3a and H3b), there is an interaction between learner's mindset and self-reflection on fear of negative evaluation (b = 0.21, p = 0.015 with a fixed mindset, 95%CI = [0.041,0.371], M11 of **Table 3**; b = –0.19, p = 0.030 with a growth mindset, 95%CI = [–0.353, –0.019], M12 of **Table 3**). This result indicates that learners with a growth mindset have a much lower fear of negative evaluation when they also reported performing self-reflection regularly (**Figure 1**). On the contrary, learners who have a fixed mindset and are reported to perform self-reflection have a significantly higher fear of negative evaluation (**Figure 2**). The results confirm our hypothesis that self-reflection is a strategy more appropriate for learners with a growth mindset. Further analysis showed that the interaction between mindset and self-compassion on fear of negative evaluation is non-significant.

Discussion

Study 1 seeks to understand whether growth and fixed mindset affect our learning outcomes and unravel the mechanisms that moderate the learning process and learning outcomes. Our results show that learners with a growth mindset are associated with the mastery goal consistent with past findings. In contrast, learners with a fixed mindset are associated with the performance goal. Our results also indicated that learners with a relatively high growth mindset benefit from self-reflection. Specifically, learners who have a relatively high growth mindset and reported self-reflection reported a lower fear of negative evaluation. On the contrary, learners with a fixed mindset have a higher level of

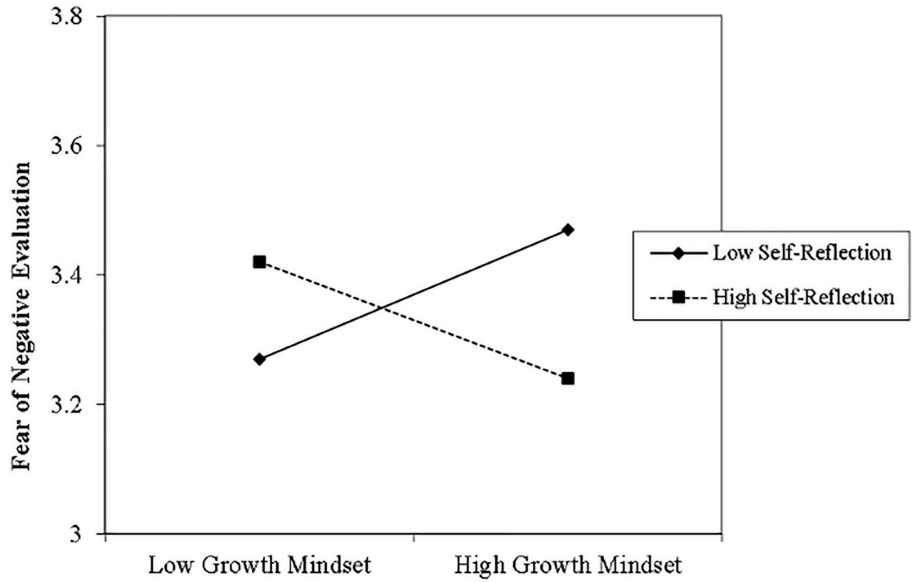

FIGURE 1 | Effect of self-regression on growth mindset and fear of negative evaluation.

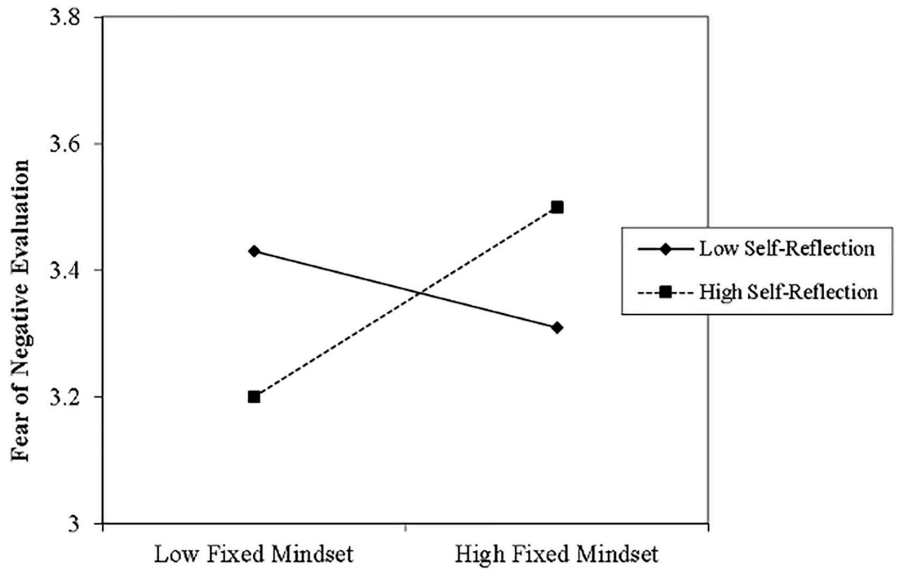

FIGURE 2 | Effect of self-regression on fixed mindset and fear of negative evaluation.

fear of negative evaluation if they reported engaging in self-reflection than other fixed mindset learners who reported lesser engagement in self-reflection. The current findings allude to the possibility that self-reflection can potentially enhance the learning process for learners with a growth mindset. But at the same time, this mechanism could potentially be damaging for learners with a fixed mindset.

Early on, we propose that self-compassion should moderate the relationship between a fixed mindset, learning process, and learning performance. Yet, in the current study, we failed to find significant results in this relationship. We speculate that the primary reason for the null findings would be the self-report nature of Study 1. Study 1 engaged only in self-report measures without assessing their learning process or learning outcomes. The results are shown in Study 1 perhaps have a robust effect in establishing the general relationship among mindsets, self-reflection (self-compassion), and learning outcome. However, the results lack the power to understand how self-reflection or self-compassion impact growth and fixed mindset learners in an actual learning task. Study 1 also only reports learners' general tendency to self-reflect or perform self-compassion acts without knowing whether such general direction can be translated into

task-specific results. The self-report measures could also be subjected to social desirability and extremity biases. In addition to the above, while our CFA model confirms a relatively good fit to support us in exploring these variables separately, and regression models support our hypotheses, the sample size is relatively small in Study 1 and is a limitation on the current Study. Therefore, to properly test the hypothesized relationship, and to show the causal inference of the hypothesized psychological mechanism, an experimental design will be used in Study 2.

STUDY 2

Participants

We recruited 99 participants from a public University (76.8% female, mean age = 18–24, see **Table 1**). They were asked to contact the experimenter via email and they were scheduled according to their preferred time slot based on the availability. The Study has received IRB ethics approval, and all the participants received and signed the informed consent and were debriefed after the experiment. Participants were randomly assigned into either the self-reflection condition (N = 33), the self-compassion condition (N = 32), or the control condition (N = 34).

Procedure

Upon arrival for the Study, participants were told to switch off their cell phones. They were told that they would be helping review course materials for a newly developed course in the University and will be asked to provide feedback on their experience later. In order to do so, they will be asked to follow the instruction given to them and complete some exercises. They were given 1 h to complete the Study, and all of the participants finished the Study within 45 min. The measure section will explain the specific manipulation used in the three experimental groups.

Measures

To understand the interaction outcomes for growth (fixed) mindset and reflection (self-compassion) on the learning process and learning outcomes, we conducted experimental testing where participants will complete two logical deduction tests during the experimental period. Participants were randomly assigned to either one of the following conditions: the self-reflection condition, the self-compassion condition, or the control condition. Participants were asked to turn off their cell phones to complete the task without distractions. They were first given the logical deduction task to complete—the task comprised ten questions in spatial, diagrammatic, and verbal reasoning. Participants were given 10 min to complete the logical deduction task. Upon finishing the task, participants were asked to indicate the perceived level of difficulty and perceived competence compared to others in the test.

In the self-reflection group, the Gibbs Reflective Cycle (Gibbs, 1988; Vaage, 2009) was adopted and modified for this task. Participants were asked to read the self-reflection guide and provide brief answers to the questions. In particular, the reflection

TABLE 4 | Regression for Study 2 (self-reflection).

	Performance					Perceived difficulty					Perceived self competence					Intention to review				
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20
Intercept	5.73	5.74	5.52	5.73	5.62	−13.22	−13.21	−13.64	−13.21	−13.97	49.75	49.83	48.03	49.77	48.76	1.19	1.19	1.21	1.19	1.2
Gender	−0.39	−0.4	−0.36	−0.39	−0.43	−0.48	−0.48	−0.41	−0.48	−0.77	2.37	2.26	2.58	2.34	1.95	0.07	0.07	0.06	0.07	0.07
Age	−0.13	−0.14	−0.13	−0.07	−0.11	0.88	0.87	0.89	0.93	0.7	−3.37	−3.5	−3.39	−3.01	−3.32	−0.03	−0.03	−0.03	−0.04	−0.04
Edu	0.19	0.15	0.13	0.04	0.1	1.32	1.3	1.26	1.16	1.61	2.19	1.87	1.7	1.17	1.78	0.03	0.04	0.04	0.06	0.05
Self-reflection (SR)	−0.12	−0.18	−0.15	−0.23	−0.2	−3.78	−3.81	−3.75	−3.9	−3.65	−0.48	−0.94	−0.68	−1.26	−0.92	.	0.01	0.01	0.02	0.02
Fixed mindset		−0.27	−0.27				−0.14	−0.14				−2.06	−2.07				0.04	0.04		
Fixed mindset × SR			−0.98***					−1.84					−7.79*					0.08		
Growth mindset				0.59	0.43				0.61	−0.5				3.92	2.44				−0.09	−0.09
Growth mindset × SR					0.52+					3.57					4.79					−0.03
R^2	0.03	0.04	0.2	0.09	0.13	0.03	0.03	0.04	0.03	0.06	0.03	0.03	0.13	0.05	0.08	0.03	0.04	0.09	0.08	0.09
ΔR^2		0.01	0.17**	0.06	0.1		0.01	0.01	0.01	0.03		0.01	0.1	0.02	0.05		0.01	0.06	0.05	0.06

+$p < 0.10$; *$p < 0.05$; **$p < 0.01$.; ***$p < 0.001$

guided them to reflect on the logical reasoning task in the first part of the experiment. The questions in the Gibbs Reflective Cycle systematically guided the learners to understand their feelings and experiences when they first complete the task, the changes they could have made, and the action plans they can carry out to make such changes. The reflective exercise included questions such as, "How did you feel about this test? What will you do differently in this type of situation the next time? What are the new areas of growth for you? What should you do to achieve it?"

Breines and Chen's self-compassion paradigm was adopted and modified for the current design in the self-compassion group. Similar to the self-reflection exercise, participants were asked to follow the questions to think about their own experiences and give brief answers to the questions. Same as the self-reflection task, participants were asked to think about their feeling and experiences of the logical reasoning task at the beginning of the exercise. Then participants were asked to read a guide to practice self-compassion. An excerpt from the procedure is: "Pay attention to your feelings now. If you faced any difficulty with the previous test, you are not alone. It is common for people to face difficulty for tests like this. If you still feel bad about how you did, try to treat yourself with more kindness." Following the passage, participants were asked to write a few lines to express compassion, understanding, and acceptance of the difficulties they faced in the previous logical deduction task.

In the control group, participants were asked to answer some factual questions about the logical reasoning task, such as, "Pay attention to the task you have completed before, what did you do? Use a few sentences to describe the task to your friend who will complete the test later." The length of the self-reflection, self-compassion, and control group exercises and the length of participants' responses were controlled to be approximately the same across the conditions. There were no significant differences in the number of words in the participants' responses across the three states.

Upon completion, participants were asked to fill out a battery of short tests, including the revised implicit theories of intelligence scale (*8 items on a 6-point Likert scale) (1 = strongly disagree, 6 = strongly agree)* (De Castella and Byrne, 2015),ω *= 0.84 for growth-mindset and*ω *= 0.87 for fixed mindset*.

After finishing with the standardized questionnaires, participants were asked to complete a second logical reasoning test (hereafter called "test 2") with the same question types and formats as the previous test (hereafter called "test 1"). Same as test 1, they were asked to indicate the perceived difficulty level and perceived competence. As a behavioral measure in understanding how participants face their failure, we asked participants how much they wanted to review the questions they did wrong (intention to review) on a Likert scale (7 = very much want to 1 = not at all want to). Afterward, they completed standardized demographic information and were fully debriefed.

Analysis Strategies

As in Study 1, we have conducted mean, standard deviation, Pearson bivariate correlation analyses, and multiple regression analyses were performed in this Study. Given the increasing critical comments regarding Cronbach's alpha as an internal consistency measure, we have adopted to use the McDonald's Omega (McNeish, 2018) to document the internal consistency of our scale in this paper. Analyses were conducted using SPSS Version 24 and R software 4.1.1. We ran descriptive statistics, and regression models in both R and SPSS. All of the means, SD, correlation indexes, beta, confidence interval, p-values are reported within the text and or within the tables and figures.

Results

To compare the effect of self-reflection and self-compassion, we created a dummy variable called self-reflection by recoding the self-reflection group as 1 and the control group as 0. Like the self-reflection group, self-compassion was created as another dummy variable by recoding the self-compassion group as 1 and the control group as 0. We hypothesized that self-reflection is an effective strategy for learners with a growth mindset and not for learners with a fixed mindset. However, after controlling participant's gender, age, and education level in the regression model, we found a significant interaction between fixed mindset and self-reflection on their performance outcomes (b = –0.98, p = 0.001, 95%CI = [–1.546, –0.410], M3 of **Table 4**) and their perceived self-competence on the task (b = –7.79, p = 0.012, 95%CI = [–13.799, –1.772], M13 of **Table 4**). Those learners with a fixed mindset and who engage in the self-reflection condition perform worse and perceive lower self-competence than those in the control condition, where they did not perform any self-reflection on the task (**Figures 3**, **4**). On the contrary, the interaction between learners with a growth mindset and self-reflection on performance is marginally significant (b = 0.52, p = 0.090, 95%CI = [–0.083, 1.126], M5 of **Table 4**), supporting our H4a. The results indicated that learners with a growth mindset and who performed the self-reflection on the task showed the highest performance level compared with the control group (**Figure 5**). We also hypothesized that self-compassion is a strategy that can mitigate the negative effect of a fixed mindset has on learning (i.e., H4b). Our results are consistent with our prediction, and there is a significant trend in the interaction between a fixed mindset and self-compassion on the intention to review (b = 0.09, p = 0.088, 95%CI = [–0.013,0.183], M18 of **Table 5**). Participants with a fixed mindset are more confident in coping with failure and are more inclined to review what they did wrong in Test 2 (**Figure 6**). On the contrary, there is a significant interaction between growth mindset and self-compassion on the perceived difficulty of the task (b = 7.01, p = 0.041, 95%CI = [0.294, 13.716], M10 of **Table 5**). Learners who have a growth mindset and were in the self-compassion condition perceived the test as much more difficult than those in the control condition (**Figure 7**).

Discussion

Study 2 provides a parsimonious test on actual test performance using an experimental design. In the current study, participants were exposed to a novel logical deduction task and were asked to perform self-reflection and self-compassion strategies. Subsequently, their actual performance, their perceived competence, and whether they will take subsequent actions

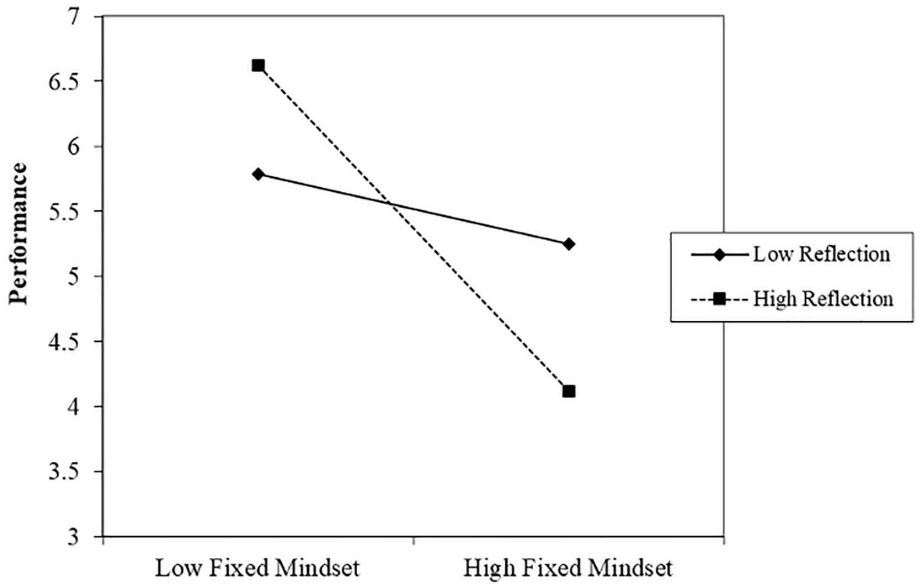

FIGURE 3 | Self-reflection on fixed mindset and performance.

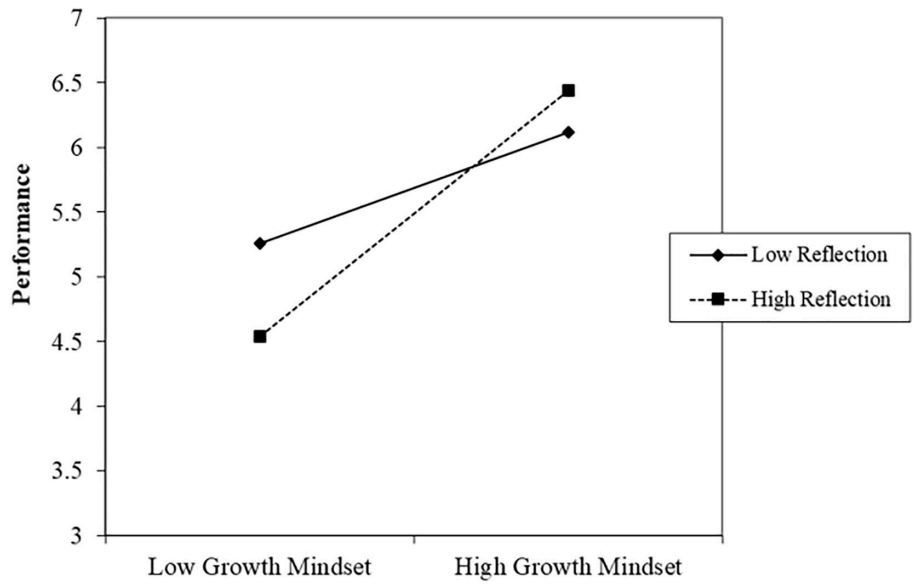

FIGURE 4 | Self-reflection on growth mindset and performance.

to enhance their performance for the future similar task (intention to review) were being measured. The results are consistent with our hypothesis, participants with a higher growth mindset and at the same time perform the self-reflection task has the highest performance level outcome. Participants with a higher fixed mindset also find self-compassion strategies to be helpful. Specifically, when higher fixed mindset participants perform self-compassion strategy, they are better at coping with failure. They are more motivated to put in effort in improving for future trials (intention to review). As mentioned earlier, the difficulty in coping with failure and failure to persevere in tasks were two critical variables linked to poor performance for learners with a fixed mindset. Interestingly, their performance outcomes decreased when learners with a higher growth mindset performed the self-compassion task. The results support our assertion that there is a need to understand the psychological mechanisms that govern the two implicit mindsets and the complementary strategies that can help learners improve their performance.

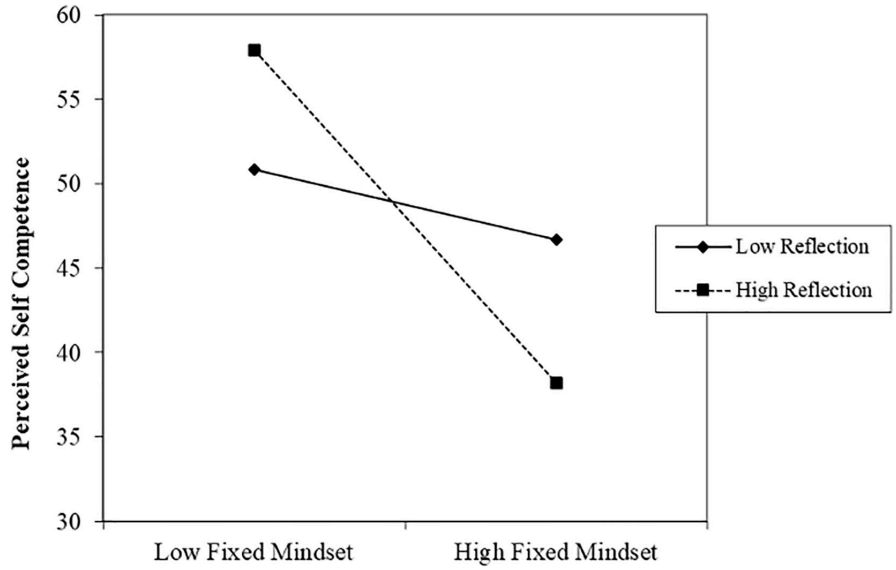

FIGURE 5 | Self-reflection on fixed mindsets and perceived self-competence.

GENERAL DISCUSSION

Having a growth mindset has been pivotal for teachers, parents, and learners alike. The positive effect of growth mindset has been widely demonstrated in past studies across learners in different age groups. Yet, studies that try to improve the positive strength between mindset and performance outcomes were inconclusive. Hence, there is an urgent need to understand how we can leverage both the growth and the fixed mindset to produce desirable learning processes and outcomes. One of the key defining differences between learners with growth versus fixed mindsets is dealing with failure. While learners with a fixed mindset treat failure as a personal blow, they often shut down after receiving negative feedback. Learners with a growth mindset treat failure as an everyday learning process and are more inclined to learn from failure. The current study shows that growth mindset learners' learning process and performance outcome can be enhanced via self-reflection practice. In contrast, fixed mindset learners learning process and performance outcome can be improved via self-compassion practice.

The contributions of the studies are three folded. First, past studies have often emphasized the "changing" of one mindset from growth to fixed, yet, past studies have failed to acknowledge that growth and fixed mindsets learners are experiencing different psychological mechanisms in their learning trails, and hence using a one-size-fits-all strategy can often backfire and diminish the effort in "changing" ones' mindset. For example, past research has repeatedly shown that learners with a growth mindset have a much easier time facing adversity. They could bounce back sooner, accept negative feedback easier, and are more likely to pick up challenging tasks after failures (see the section "Introduction" in this paper). The reverse patterns are observed for learners with a fixed mindset. They are more likely to feel emotionally defeated after setbacks and are less likely to pick up challenging tasks after failure. The responses documented in the mindset literature reflect that attribution that learners made differed when they held the growth versus the fixed mindset. Dweck has also elucidated the mindset theories to the attributional (Weiner and Kukla, 1970) and motivational theory (Elliott and Dweck, 1988) behind it. Specifically, the learning outcomes of learners are heavily influenced by the attributions they make when they experience success or failure, and such attributions affect their motivation for future tasks. While learners with a growth mindset attribute success and failure to external effort, fixed mindset learners attribute success and failure to intrinsic personal factors. The current study results corroborate past evidence that different mindsets and attributions impact their learning process and outcomes. However, most importantly, it identifies the two separate psychological mechanisms that help elucidate what goes on in the learners' minds when making such attribution. Furthermore, the current study identifies how this knowledge can enhance their learning process and outcomes. Future studies can also study how self-reflection and self-compassion can change attributional responses in the learning process for learners with growth versus fixed mindset to test the relationship among attributions, mindsets, and self-reflection (compassion) on learning outcomes.

Secondly, identifying the corresponding pathway (self-reflection vs. self-compassion) that facilitates different mindsets (growth vs. fixed) to better their learning process and outcomes give new insights on how we can further enhance the benefits of a growth mindset and mitigate the negative effect of a fixed mindset. As mentioned in the introduction, growth and fixed mindset are often viewed as a single pathway, and parents and teachers are often expected to change students' mindsets using a one-size-fits-all method. As documented in past literature, many educators focused on creating a growth mindset learning

TABLE 5 | Regression for Study 2 (self-compassion).

	Performance					Perceived difficulty					Perceived self competence					Intention to review				
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**M13**	**M14**	**M15**	**M16**	**M17**	**M18**	**M19**	**M20**
Intercept	5.73	5.75	5.69	5.74	5.66	−13.19	−13.21	−13.53	−13.19	−14.2	49.8	49.92	49.62	49.84	49.76	1.19	1.19	1.2	1.19	1.2
Gender	−0.42	−0.43	−0.34	−0.43	−0.39	0.36	0.38	0.89	0.36	0.88	1.33	1.23	1.72	1.3	1.34	0.07	0.07	0.05	0.07	0.06
Age	−0.18	−0.21	−0.31	−0.15	−0.36	0.13	0.2	−0.33	0.12	−2.44	−3.93	−4.25	−4.76	−3.75	−3.95	−0.03	−0.02	−0.01	−0.03	−0.02
Edu	0.18	0.13	0.19	0.01	0.15	1.25	1.36	1.67	1.29	3.08	1.94	1.48	1.78	0.6	0.74	0.03	0.04	0.03	0.06	0.05
Self-compassion (SC)	−0.3	−0.34	−0.25	−0.42	−0.37	0.02	0.12	0.59	0.05	0.62	−5.44	−5.87	−5.42	−6.38	−6.33	0.01	0.01	.	0.02	0.02
Fixed mindset		−0.29	−0.25				0.62	0.82				−2.72	−2.53				0.04	0.04		
Fixed mindset × SC			−0.52 +					−2.71					−2.57					0.09 +		
Growth mindset				0.63	0.59 +				−0.16	−0.58				4.9	4.87				−0.09	−0.92 +
Growth mindset × SC					0.56					7.01*					0.56					−0.04
R^2	0.04	0.06	0.1	0.1	0.14	0.01	0.01	0.02	0.01	0.07	0.07	0.08	0.09	0.11	0.11	0.03	0.04	0.09	0.08	0.09
ΔR^2		0.01	0.06	0.06	0.1		0.01	0.01	0.01	0.06		0.01	0.01	0.04	0.04		0.01	0.06	0.05	0.06

*+p < 0.10; *p < 0.05; **p < 0.01.*

environment for their students and heavily trained their teachers in "praising students' effort." While some schools documented improvement in their students, others were not as lucky. Some educators even found that praising students' efforts lowered students' learning outcomes in the long run, leading to the term "false growth mindset." Dweck explained that this effect is likely due to educators' inability to decipher whether students have used the appropriate "strategies/efforts" in learning, and praising the "inappropriate strategies used" will likely lead to adverse learning outcomes (Dweck and Yeager, 2019). Our results can provide new insights in understanding the different kinds of strategies (self-reflection versus self-compassion) that should be deemed appropriate when applying them to different types of learners.

Lastly, the findings also provide huge practical usage for teachers in the classroom. Specifically, teachers can use corresponding learning strategies (self-reflection or self-compassion) appropriate for students with different mindsets. Inconsistency findings previously reported in the mindset literature can partially be attributed to the inconsistency in the methods being employed by educators in the classroom. Often, educators were asked to create a "growth mindset learning environment" and were left to their devices on how to implement it. Moreover, confounding variables can affect teaching effectiveness (for example, the teacher's mindset affects students' learning outcomes) beyond strategies used to shape students' mindsets (Murphy and Dweck, 2010). The current study provides a highly replicable set of strategies for educators to follow and adapt and is applicable in most educational settings.

While the current study provides a new perspective on how self-reflection and self-compassion can help enhance performance outcomes for learners with different mindsets, the studies also have their limitations. For example, while there is a significant effect between our two experimental conditions (self-reflection versus self-compassion), manipulation check should be implemented in Study 2 to assess the validity of the design. Our sample also consists of only college students who are likely to adapt to other modes of learning strategies (e.g., self-compassion and self-reflection). While the results are robust enough to show that even students who adapted to different learning strategies can be manipulated and display the predicted results, future studies should apply this paradigm to learners in different age groups. Secondly, the goals of learning often interfere with their learning process. In Study 1, we have used learning goals motivation as a proxy for learning outcomes, and in Study 2, we used actual learning performances as our dependant measures. In combination, the current set of the study indicated that self-reflection and self-compassion strategies could affect growth and fixed mindset learners differently. Future studies should also understand whether learning motivations change or moderate the actual learning process and learning outcomes in experimental designs. Lastly, our current study is experimental in nature, but learning often happens over time with repeated trials and practices. Therefore, future studies should explore the effect these strategies (self-reflection vs. self-compassion) have on the learner's mindset over time. Literature has also documented that learners with a metacognitive mindset are better at transferring knowledge and can impact learning outcomes

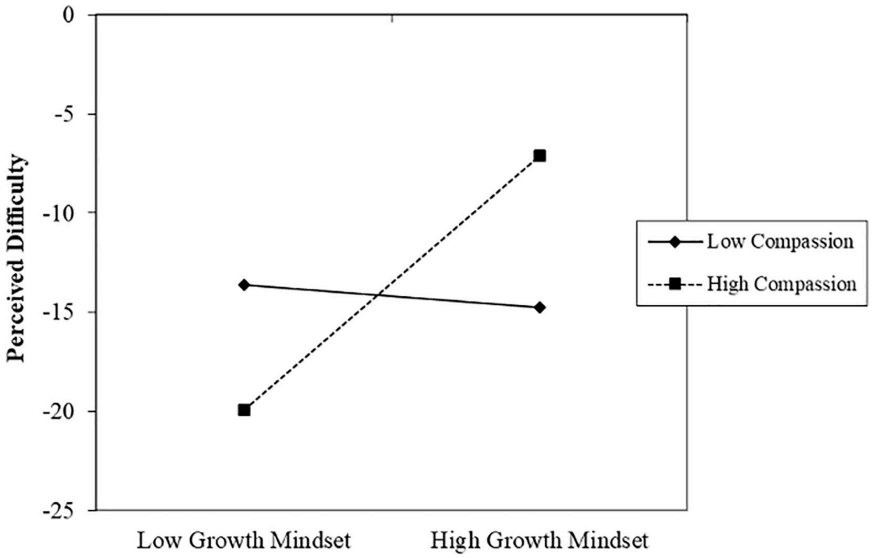

FIGURE 6 | Effect of self-compassion on growth mindset and perceived difficulty.

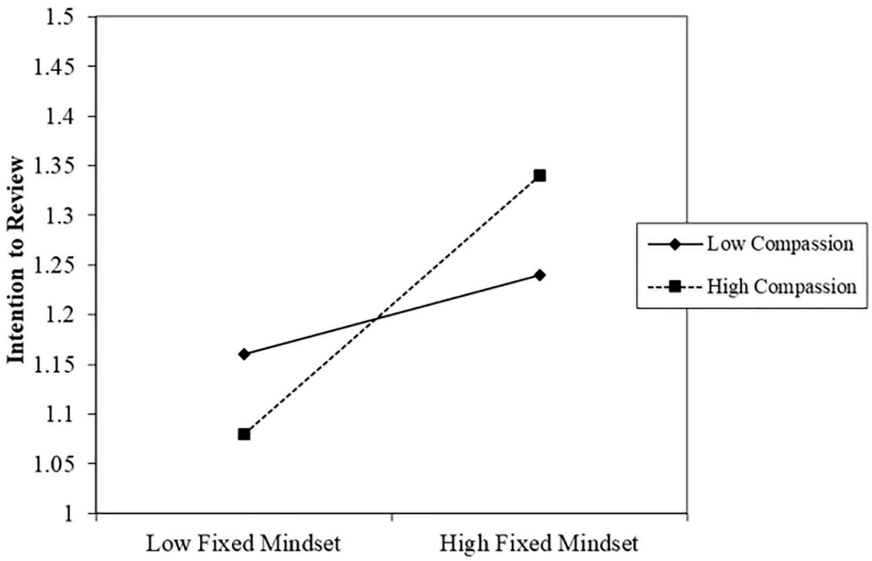

FIGURE 7 | Effect of self-compassion on fixed mindset and intention to review.

for growth and fixed mindset learners. Future research should address the mechanisms of the proposed strategies and their relationship with the metacognitive mindset (Ford et al., 1998).

Recent theories have also suggested that motivation (such as learning mindsets) can promote trait changes (e.g., personality) (ref. Dweck, 2019) as our mindsets can promote a sense of fluidity in being. Future studies should also explore these possibilities in learners.

Learning strategies can enhance or damage students learning process and learning performance depending on the learner's mindset in our current study, but perhaps what is interesting is based on the present findings, to understand the learning evolution within individual learners and seek to understand the effect of these strategies (self-reflection vs. self-compassion) in changing learners' mindset over time. It is possible that learning strategies can interact with students' mindsets to produce positive or negative changes in students' performance down the road. For example, with self-compassion training, individuals with a fixed mindset can recognize the changeable quality in their learning progress over time. Recognizing such personal changes can enable learners with more fixed mindsets to perceive growth in their abilities as a possibility. Future studies should employ a longitudinal method to understand how mindset interacts with self-reflection and self-compassion strategies over time.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Chinese University of Hong Kong. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LK and LL came up with the research paradigm and the design of the study. LK, LL, and YH collected the data for the studies. LK and YH participated in the data analysis and the wrote–up of the studies. All the authors contributed to the article and approved the submitted version.

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