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Can Growth Mindset Affirmation be Advantageous for More-knowledgeable Learners?

Noka Setya Maharani [1]*, Endah Retnowati [2], Ellen Lee [3]

[1,2] Departemen Pendidikan Matematika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Yogyakarta, Indonesia

[3]University of New South Wales, Sydney, Australia

*Corresponding Author. E-mail: e.retno@uny.ac.id

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Abstract

Growth mindset is known as a believe that intelligent can be learned. Learning anxiety might occur due to self-doubt that one has an ability to learn, such as in a complex topic in mathematics. Therefore, it is assumed that a positive affirmation that directs growth-mindset might be used to manage anxieties in learning mathematics. This study was aimed to investigate that beside the worked example might increase extraneous cognitive load for more knowledgeable learners, it might also be possible it affects anxiety. A total of 128 Indonesian junior high school students were randomly placed in four experiment groups by using the 2x2 factorial design (with vs. without growth mindset affirmation) x (worked example vs. problem solving based instruction) to examine the instruction on transfer abilities, cognitive loads, and level of anxieties. Using ANOVA(s), findings support the expertise reversal effect that the worked examples were disadvantageous for more knowledgeable learners. The data reveals that they also experienced significantly higher anxiety during learning compared to the counterparts. Nevertheless, no effects were found in favor of the growth mindset affirmation.

Keywords: cognitive load theory, growth mindset, affirmation, worked example, expertise reversal effect

INTRODUCTION

The cognitive load theory (CLT) is a theory in instructional designs which focuses on how our cognitive structures processes information during learning and solving problems. The theory, concerns with the limiton of novice learners in managing new information, and hence, sufficient guidance during instruction should be used. This case could be in contrast for students who are more knowledgeable or expert learners, they do not require explicit guidance in problem solving. An Instruction could be effective for novice but not for expert learners, and this is called expertise reversal effects (Kalyuga et al., 2003). Solving a problem by using the conventional learning method may cause heavy cognitive load for novice whether solving it individually or in group works (Retnowati et al., 2010). Therefore, designing instructions should consider how much cognitive load will be caused for particular learners (Sweller et al., 2019).

The use of worked examples for less-knowledgeable learners has been recommended (Sweller et al., 2011b). A worked example provides step-by-step problem solution that are presented in structured manner and easy to grasp by applying the cognitive load principles (Retnowati & Marissa, 2018). The element of interactivity in every solution step should be considered because each step might require different level of cognitive load (Chen et al., 2023). The principles of borrowing and reorganizing that novice learners "borrow" new information from the solution steps assist them to acquire new knowledge (Sweller et al., 1998, 2019). In other words, novice learners use the new knowledge through the instructional guides in the worked example to guide their learning. Without the worked example, novice learners would follow the randomness technique is used as a genesis principle, where learners randomly match any information to form the problems solutions. Aside learning, novice learners might experience cognitive overload in their working memory (Retnowati et al., 2010). The absence of a guide to solve the problems can cause a means-ends analysis that can bring about a high extraneous cognitive load so that learning will be inhibited (Van Gog et al., 2004). The instructional guide can act as a substitute for the lost scheme and, if effective, it will perform the function of building a knowledge scheme (Kalyuga et al., 2003), such that it can effectively minimize the working memory load (Sweller et al., 1998).

The instructional guide for the worked example will assist learners to understand the problem and the way to solve it step by step. There are many research that explain the effectiveness of this instruction (Chen et al., 2023). In order to motivate learners in automatizing the new knowledge learned from the worked example, a pair of isomorphic problems can be given after each example is given. Learners are asked to recall the knowledge that they have built based on the work example (Pastoriko & Retnowati, 2019). By this way, students practice and elaborate their understanding of the worked example. The advantage of worked example for more-knowledgeable learners who have possessed adequate knowledge base for the presented problem solving. The presented worked example might be redundant with the knowledge in their long-term memory causing learning becomes clumsy. This is called the expertise reversal effect (Kalyuga et al., 2003). The escalation of the cognitive load during learning may impede learning, and therefore these students are better without worked examples (Kalyuga et al., 2001, 2003; Renkl & Atkinson, 2003; Sweller et al., 2019).

It has been widely known that a few students might feel anxious when learning mathematics (Ashcraft, 2002; Dowker et al., 2016; Maloney & Beilock, 2012; Ramirez et al., 2013). When learners experience a math anxiety, their power resources in their working memory will be drawn to this anxiety so that their capacity to finish the task which is relevant to learning is inadequate (Klados et al., 2019) and their knowledge construction is not optimal so that it hampers their ability to effectively transfer their knowledge that they have learned (Ashcraft, 2002; Ashcraft & Kirk, 2001). There might be various factor contributing to anxiety, such as the feeling of lack of ability (Ashcraft & Kirk, 2001; Pekrun, 2006), lack of support (Hembree, 1990; Ramirez & Beilock, 2011), or high challenge (Ashcraft & Faust, 1994; Dowker et al., 2016; Pekrun, 2006; Ramirez et al., 2013). Problem solving in mathematics may be seen as a challenge task including for knowledgeable learners. To some circumstances, hence, problem solving might cause students to feel anxious. Samuel, Buttet, & Warner (2022) dan Samuel & Warner (2019) have shown through their research studies that growth mindset intervention becomes one of the endevours that can be used to deflate anxieties towards learning mathematics. At the moment when math anxieties are being managed, the working memory resource can be fully invested to organize information that is relevant to the content materials in learning and support the construction of knowledge schemes and transfer capacities.

Dweck (2015) described that developing growth mindsets in the class is by focusing on building and germinating abilities, regarding success as achieving a goal and improving skills, taking errors not as failures but a reframing of the problem that needs a different strategy to solve, and through this process, knowledge will be enriched. It is why learners with a growth mindset will make an effort to overcome their challenges because they believe that ability and intelligence can be changed through efforts, practices, and learning (Dweck S., 2015). Duckworth et al. (2019) stated the same thing by defining a growth mindset as optimistic ways in facing various problems so that perseverence will grow in solving them and, utimatey, they will grow into indivials with stronger personalities. Van Hoeve et al. (2023) mentioned three aspects of the growth mindset, namely: (1) neuroplasticity, i.e. belief that talents and abilities can be developed by ways of efforts and hard work; (2) learning from mistake, a belief that difficulties and failures challenge which give the opportunities to contend challenges by trying new things; and (3) feedback, i.e. a conviction that criticisms from others are means of finding ways to improve and be successful. Positive affirmative is one of the growth mindset strategies in the social cognitive theory that explains thinking abilities that abilities and skills are not constant, but they can be develop through hard efforts and practices (Mills & Mills, 2018). Positive affirmation in the forms of supportive statements might direct student's engagement in learning. This might reduce the feeling of lack of support, and hence reduce anxiety.

Integration of positive affirmation in instructional designs based on worked examples might improve learning. Positive affirmation, as a growth mindset strategy, is assumed to reduce anxiety and enhance learners' confidence, potentially increasing their engagement with worked example. However, (Xu et al., 2021) argues that while the idea of growth mindset is popular, there is limited cognitive load theory-based evidence supporting its efficacy in instructional contexts. They emphasize that instructional designs should prioritize evidence-based principles rather that popular psychological constructs unless clear empirical support is established. Similarly, Sisk et al. (2018) in their meta-analysis found that the effects of growth mindset interventions on academic achievement are generally small and context-depedent, suggesting the need for more rigorous investigation. Therefore, although the integration of positive affirmation into worked example-based instruction is theoretically promising, empirical evidence for its effectiveness remains limited and is still heavily required.

The main objective of the present study is to expand research which applies the principles of worked example effect with the growth mindset by adding positive affirmation prompts in the instruction. It is expected that novice learners can get advantages from worked example, as compared to studying problem solving only, and vice versa. For this reason, it is hypothesis that expertise reversal effects might also cause anxiety to more-knowledgeable learners when studying with worked examples. This study aimed to find evidence that added positive affirmation prompts as a growth mindset intervention might eliminate the expertise reversal effects, and hence lower math anxieties.

METHODS

Participants and Research Design

A number of 128 eighth-grade students (age mean = 13.85; 59 boys) in four mathematics classes in one Indonesian Junior High School was recruited. The students used a National Curriculum, the time of the experiment was conducted, and therefore, it can be assumed that all students had fairly similar mathematical experiences. The curriculum specified the learning materials and required competencies, making them mandatory for all participants. According to the mathematics teacher, the students had already learned the relevant mathematical topic (lines and angles) in previous lessons. In addition, the teacher reported that students had completed classwork and assessments on this topic before the study took place. These factors indicate that the students possessed prior knowledge of the concepts involved. Therefore, based on their previous instruction, exposure, and practice with the material, the students were categorized as more knowledgeable learners, consistent with the definition of learners who have had prior experience and familiarity with the learning domain (Kalyuga, 2007).

A factorial design was used by 2 [learning instructional strategies = worked example (WE) vs. problem solving (PS)] × 2 (growth mindset strategies = with positive affirmation vs. without positive affirmation prompts), randomly placed the participants in one of the four research groups: (1) worked example with positive affirmation (n = 32); (2) worked example without positive affirmation (n = 33); (3) problem solving with positive affirmation (n = 31); and (4) problem solving without positive affirmation (n = 32). All participants had the taken line and angle class, especially relations among angles as a result of two parallel lines being crossed by a transversal line, so that all sample in the study could be regarded as more-knowledgeable learners.

The Research Ethics Commission of Yogyakarta State University rendered the ethics consent for the conduct for the study under the issuance number: No. T/20/2/UN34.9/KP.06.07/2024. Writing tools and refreshment snack food were given out to the participants as compensation rewards.

Instruments

Learning Instrument

The content material used in the study consisted of lines and angles, especially relations among angles as a result of two parallel lines being cut by a transversal line. The instructional material was presented in the forms of student work sheets (worksheet) in the printed format. The worksheet contained five pairs of problems with a complexity which was quite high so that, for learners to be able to work, it needed understanding of the characteristics of lines and angles and learners needed to manipulate pictures using aiding lines. In addition, the worksheet was printed in 18 pages of paper consisting of: (1) guide to using the worksheet and learners' identities; (2) brief content material related to alternative aiding lines that could be drawn to make it easy for learners to finish the task; (3) for the worked example group, containing a work example completed with structured and complete the instructional guides that must be followed in order by participants and, while for the problem solving group, containing an identical problem that must be done by participants; (4) problems each of which was consecutively ordered in the same way as the problem examples that must be be done by participants; (5) cognitive scales that must be completed by participants to show the cognitive load levels experienced by participants when working on and finishing the problem items. This study used five pairs of WE-PS (for worked example group experiment) or PS-PS (for problem solving group experiment). Figure 1 shows a fragment of a worksheet worked example and Figure 2 a fragment of a worksheet problem solving used in the study.

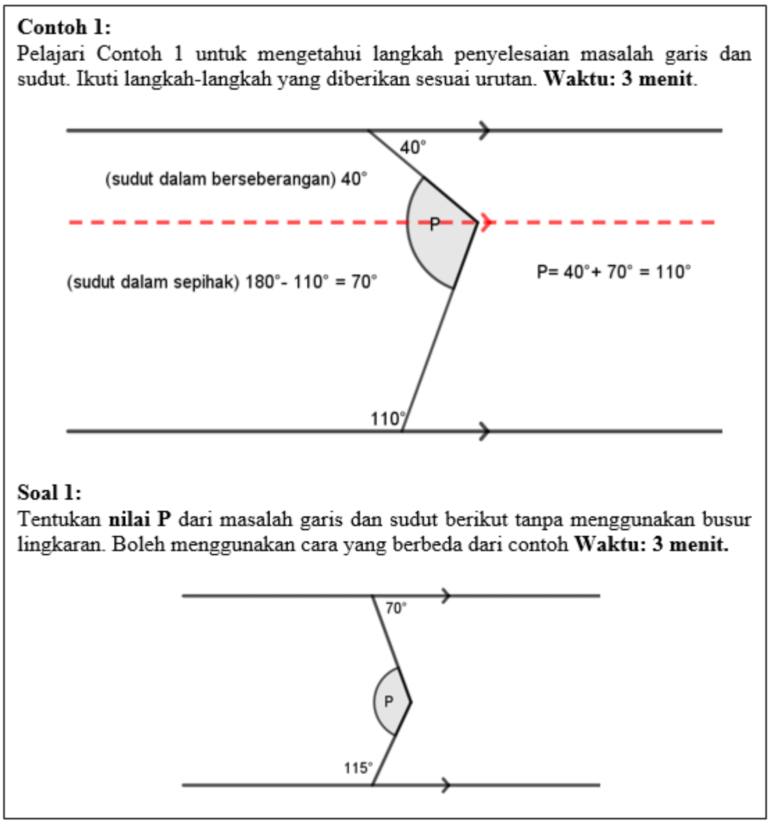
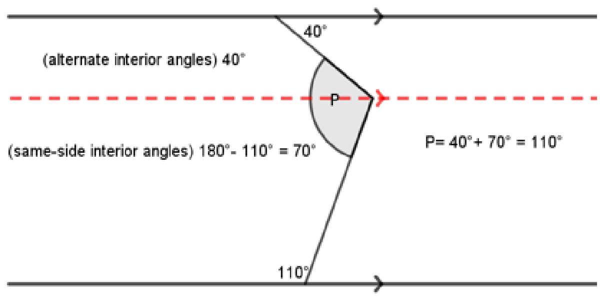


Figure 1a. Excerpt of a worked example in worksheet (*original version*)

Example 1:
Study Example 1 to learn the steps how to solve line and angle problem below. Study the steps in order. **Time: 3 minutes**.



Task 1:
Determine the value of P from the line and angle problem below without using circular arcs. Solving in a different way than the example is permitted. **Time: 3 minutes.**

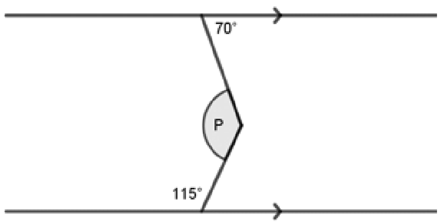
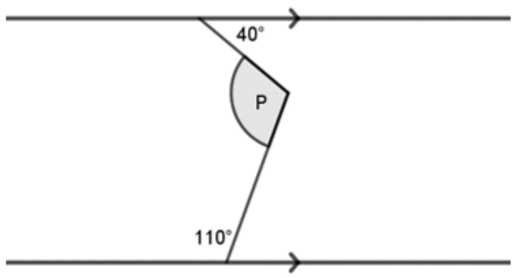


Figure 2b. Excerpt of a worked example in worksheet (*translation version*)

Soal 1a:
Tentukan **nilai P** dari masalah garis dan sudut berikut. Boleh menggunakan cara apapun, namun tidak diperkenankan menggunakan alat bantu (busur lingkaran). **Waktu: 3 menit.**



Soal 1b:
Tentukan **nilai P** dari masalah garis dan sudut. Boleh menggunakan cara apapun, namun tidak diperkenankan menggunakan alat bantu (busur lingkaran). **Waktu: 3 menit.**

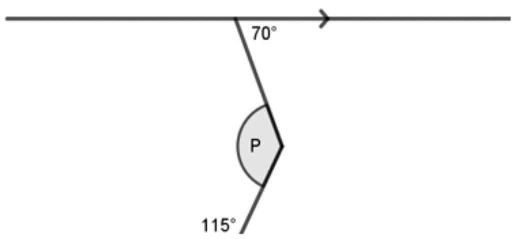
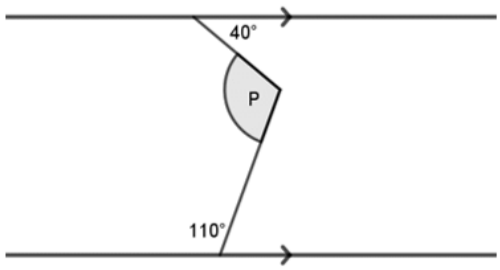


Figure 2a. Excerpt of a problem solving in worksheet (*original version*)

Task 1a:
Determine the **value of P** from the line and angle problem below. Solve it in any way, but using of aids (*i.e.* circular arc) is not permitted. **Time: 3 minutes.**



Task 1b:
Determine the **value of P** from the line and angle problem below. Solve it in any way, but using of aids (*i.e.* circular arc) is not permitted. **Time: 3 minutes.**

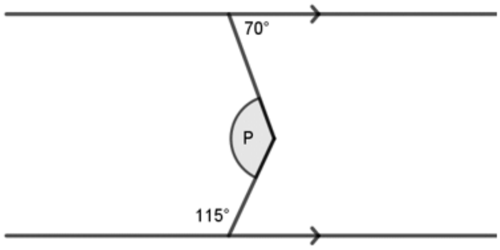


Figure 3a. Excerpt of a problem solving in worksheet (*translation version*)

From Figure 1 and Figure 2, we can see that the difference between worksheet Worked Example and worksheet Problem Solving is only in the solution steps that have been presented in worksheet Worked Example for participants to learn before solving the given task, while in worksheet Problem Solving, no solution steps are presented.

Procedure

The study was conducted in one state junior high school in Yogyakarta, Indonesia. All student participants learned to carry out all the process of the study consisting of three phases of introduction, acquisition, and test. In the introductory phase, students recalled the materials related to lines and angles, especially relations among angles as a result of two parallel lines crossed by a transversal line presented in the worksheet, guided by the teacher. This phase was conducted with the objective of activating students' prior knowledge as a provision for the next phase. The materials included opposite angles, facing angles, one-sided angles, angled corners, straight corners, number of angles in a triangle, and number of angles one full circle. It is the relations among these angles that are used by students in completing the task in the next phase. The introductory phase lasted 15 minutes.

The second phase is the acquisition phase, that is knowledge acquisition. In this phase, the students learned how to complete a task in the worksheet concerning lines and angles, especially determining the size of an angle formed by two parallel lines cut by a transversal line using at least 2-3 angles theorems. For every task, there are 3 minutes available for participants to study or work on the assigned assignment. After every problem solving task in the learning, participants reflect their own cognitive processes and the task difficulties they feel.

In the positive affirmative research group, all students will view a 2:30-minute video piece related to the principles of the growth mindset, presenting the differences between one with a fixed mindset and one with a growth mindset. The growth mindset video used has been validated by expert judgment before being used in research to ensure that the growth mindset video used is valid, in line the research objectives and the definition of growth mindset. Figure 3 is an excerpt of the growth mindset video.

Figure 4a. Excerpt of the Growth Mindset Video (*original version*)

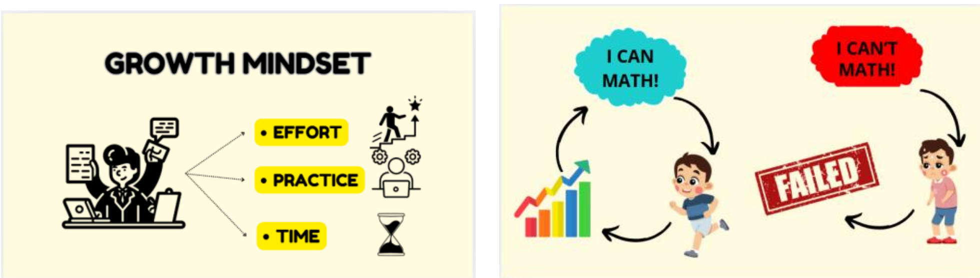


Figure 5b. Excerpt of the Growth Mindset Video (*translation version*)

After watching the growth mindset video, the participants in this positive affirmation group continued their work in the worksheet according to the experiment groupings. The positive affirmative group students were asked to read the material aloud and internalized the meaning of positive affirmation to be really appreciated by students. The positive affirmation contained 10 statements, equal to the number of problems in the worksheet. Meanwhile, the non-positive affirmative group means that they were not given the growth mindset video nor the positive affirmative prompts. The positive affirmation prompts used were adapted from (Samuel & Warner, 2019), adjusted to the tasks and skills being worked on by the participants. Table 1 are the growth mindset affirmations used in this study.

Table 1a. Growth Mindset Affirmation (*Original Version*)

Afirmasi Growth Mindset yang diberikan	
Worked Example Group Experiment	**Problem Solving Group Experiment**
WE 1: Saya bisa memahami contoh 1 ini dengan mempelajari langkah-langkah yang diberikan dengan cermat. **PS 1:** Saya bisa menyelesaikan soal 1 ini melalui usaha dan strategi yang tepat	**PS 1a:** Saya bisa mengerjakan soal 1a dengan baik **PS 1b:** Saya bisa menyelesaikan soal 1b ini melalui usaha dan strategi yang tepat.
WE 2: Meskipun contoh 2 ini tidak mudah, namun ini adalah bagian dari proses saya untuk berhasil dalam matematika. **PS 2:** Meskipun soal garis dan sudut ini tidak mudah bagi saya, ini adalah bagian proses saya agar berhasil dalam permasalahan garis dan sudut ini.	**PS 2a:** Meskipun soal 2a ini tak mudah, namun ini adalah bagian dari proses saya untuk berhasil dalam matematika **PS 2b:** Meskipun soal garis dan sudut ini tidak mudah bagi saya, ini adalah bagian proses saya agar berhasil dalam permasalahan garis dan sudut ini.
WE 3: Otak saya seperti otot, saya bisa melatih otot matematika saya dengan terus berlatih. **PS 3:** Soal ini cukup menantang, tetapi saya siap untuk mencoba menyelesaikannya.	**PS 3a:** Otak saya seperti otot, saya bisa melatih otot matematika saya dengan terus berlatih. **PS 3b:** Soal ini cukup menantang, tetapi saya siap untuk mencoba menyelesaikannya.
WE 4: Siapapun bisa memahami contoh soal 4 ini melalui langkah penyelesaian yang disajikan, termasuk saya. **PS 4:** Siaiapun bisa menyelesaikan soal 4 ini, termasuk saya. Saya akan mencoba menyelesaikannya.	**PS 4a:** Siapapun bisa menyelesaikan soal 4a ini dengan benar, termasuk saya. **PS 4b:** Siapapun bisa menyelesaikan soal 4b ini, termasuk saya. Saya akan mencoba menyelesaikannya.
WE 5: Saya mampu memahami penerapan garis dan sudut melalui contoh 5 ini. **PS 5:** Guru saya percaya, bahwa saya akan mampu menyelesaikan soal 5 ini dengan benar	**PS 5a:** Saya mampu memahami penerapan garis dan sudut melalui soal 5a ini. **PS 5b:** Guru saya percaya, bahwa saya akan mampu menyelesaikan soal 5b ini dengan benar.

Table 2b. Growth Mindset Affirmation (*Translation Version*)

Growth Mindset Affirmation Provided	
Worked Example Group Experiment	**Problem Solving Group Experiment**
WE 1: I was able to understand this Example 1 by carefully studying the steps given. **PS 1:** I can solve Task 1 through effort and the right strategy.	**PS 1a:** I can do Task 1a well. **PS 1b:** I can solve Task 1b through effort and the right strategy.
WE 2: Although Example 2 is not easy, it is part of my process to succeed in math. **PS 2:** Although this line and angle problem is not easy for me, it is part of my process to succeed in this line and angle problem.	**PS 2a:** Although Task 2a is not easy, it is part of my process to succeed in math. **PS 2b:** Although this line and angle problem is not easy for me, it is part of my process to succeed in this line and angle problem.
WE 3: My brain is like a muscle, I can exercise my math muscle by constantly practicing. **PS 3:** This problem was quite challenging, but I was ready to try and solve it.	**PS 3a:** My brain is like e muscle, I can exercise my math muscle by constantly practicing. **PS 3b:** This problem was quite challenging, but I was ready to try and solve it.
WE 4: Anyone can understand this Example 4 through the solution steps presented, including me. **PS 4:** Anyone can solve Task 4, including me. I will try to solve it.	**PS 4a:** Anyone can solve Task 4a correctly, including me. **PS 4b**: Anyone can solve Task 4b, including me. I will try to solve it.
WE 5: I was able to understand the application of line and angles through Example 5. **PS 5:** My teacher believes that I will be able to solve Task 5 correctly.	**PS 5a:** I was able to understand the application of lines and angles through Task 5a. **PS 5b:** My teacher believes that I will be able to solve Task 5b correctly.

The last phase was the test phase to measure participants' transfer abilities, cognitive loads, and math anxieties.

Measurement Instruments

The research instrument was prepared through validation of the learning materials with experts of mathematics education and the teacher. Consultation and discussion were conducted to ensure that all aspects of measurement have been described in the test items, so that the instrument meets the requirement of construct validity. Matching between test questions with the grid, ensuring the construction of questions is right and correct and adjusting the allocation according to student abilities is carried out in the expert judgment assessment. Afterwards, piloting was run to measure the reliability levels, as described below.

Posttest of Transfer Ability

Transfer abilities after the learning phase were measured using the near-transfer ability test and far-transfer ability test. The former consisted of three test items in the forms of essays, containing problems that were similar to the ones in the worksheet. A score of three points for each item that was answered correctly using the right steps. A maximum of 9 points could be obtained from the near-transfer ability test.

The latter, the far-transfer test, consisted of three test items in the forms of essays, containing problems that were different and had higher complexity than the ones in the worksheet; however, finishing of the problems used the same characteristics as the ones in the worksheet. Scoring was the same: three points were given to each item answered correctly using the right steps yielding a maximum total score of nine. The duration provided to complete far and near transfer test is 40 minutes. Students may only collect their work after the time runs out. The Cronbach Alpha measures of the two tests were 0.927 for the near-transfer ability test and 0.703 for the fast-transfer ability test indicating that the transfer ability instruments were reliable.

Cognitive Load Level

The cognitive load might be defined as the amount of learners' cognitive processes caused by intrinsic cognitive loads, extraneous cognitive loads, and germane cognitive loads which occupy the working memory. In daily context, this could refer to the level of difficulty in understanding the learning material. To know the cognitive loads experienced by learners, the study adapted the cognitive load subjective rating scale Paas (1992) on the 9-point Likert scale, by adapting the word mental effort into difficulty level. This subjective measurement is used because it is simple, easy to obtain, not disturbing, easy to analyze, reliable, valid, and often more sensitive to small differences in the cognitive load (Paas & Van Merriënboer, 1994). Learners reflect their own cognitive processes and the task difficulties they feel, then represent them in the 9-point Likert scale in numerical scores [from 1 (very easy) to 9 (very difficult)]. The research question that is asked in this study is: "How difficult was it for you to solve the item above?" and was given in after every problem solving task in the learning and post-test phases.

Math Anxiety

The measurement of math anxieties in this study adapted the Abbreviated Math Anxiety Scale (AMAS) developed by (Hopko et al., 2003), containing nine items divided into two factors, namely Evaluation Mathematics Anxiety (EMA) which refers to anxieties experienced by learners when they are faced with mathematics problems and Learning Mathematics Anxiety (LMA) which refers to anxieties experienced by learners when learning new mathematics. AMAS uses a 5-point Likert scale where 1 represents low anxiety and 5 high anxiety. The present study, however, uses a 9-point Likert scale, point 1 representing low anxiety and 9 high anxiety. This scale is chosen because it is sensitive to detect small variations in task complexities (Paas et al., 1994). In other words, by using this scale, it is expected that results are more accurate. Learners report the anxieties they feel in the 9-point Likert scale by translating them in numerical scores. The Cronbach Alpha measures of the two tests were 0.792 for the EMA test and 0.760 for the LMA test indicating that the transfer ability instruments were reliable.

RESULTS & DISCUSSION

Results

A significant level of 0.05 was used. Descriptive statistics are presented in table, and followed by the ANOVA(s) and Correlation(s) results. The means and standard deviations of the transfer ability scores are presented in Table 1, the cognitive load scores are presented in Table 2, the math anxiety scores are presented in Table 3, and the descriptive and correlation for transfer score, cognitive load, and math anxiety are presented in Table 4.

Table 1. Means and Standard Deviations of the Transfer Ability Scores

Learning Strategy	Growth Mindset Strategy	Near-transfer Test				Far-transfer Test			
		Min	Max	Mean	SD	Min	Max	Mean	SD
Worked Example	Affirmation	1.00	9.00	4.98	2.16	0.00	9.00	3.63	2.06
	Non-affirmation	1.00	9.00	5.47	2.34	1.00	7.00	3.21	1.42
Problem Solving	Affirmation	1.50	9.00	4.94	2.59	1.50	6.50	3.95	1.64
	Non-affirmation	1.50	9.00	5.34	2.39	1.50	9.00	3.90	2.17

Table 2. Means and Standard Deviations of the Cognitive Load Scores

Learning Strategy	Growth Mindset Strategy	Cognitive Load Near-transfer Test				Cognitive Load Far-transfer Test			
		Min	Max	Mean	SD	Min	Max	Mean	SD
Worked Example	Affirmation	1.00	8.33	5.56	1.69	3.00	9.00	7.59	1.60
	Non-affirmation	3.00	9.00	5.68	1.59	4.33	9.00	7.51	1.42
Problem Solving	Affirmation	1.00	8.00	5.27	2.24	2.67	9.00	6.66	1.93
	Non-affirmation	2.00	8.33	5.09	1.77	1.33	9.00	6.76	2.01

Table 3. Means and Standard Deviations of the Math Anxiety Scores

Learning Strategy	Growth Mindset Strategy	LMA				EMA			
		Min	Max	Mean	SD	Min	Max	Mean	SD
Worked Example	Affirmation	1.00	5.60	3.47	1.21	1.00	6.00	3.85	1.48
	Non-affirmation	1.80	5.60	3.75	1.07	2.50	8.00	4.72	1.22
Problem Solving	Affirmation	1.00	5.20	3.12	1.32	1.00	7.00	4.03	1.87
	Non-affirmation	1.00	7.20	3.17	1.35	1.25	8.50	4.00	1.65

Table 4. Descriptive and correlation for transfer score, cognitive load, and math anxiety

	1	2	3	4	5	6
1. Near transfer score	1					
2. Far transfer score	.590**	1				
3. Cognitive load near transfer test	-.493**	-.351**	1			
4. Cognitive load far transfer test	-.366**	-.546**	.535**	1		
5. Learning math anxiety	-.303**	-.259**	.489**	.403**	1	
6. Evaluation math anxiety	-.307**	-.218*	.468**	.398**	.774**	1

Notes. $N = 128$. * $p < .05$, ** $p < .01$

Main Effects: Growth Mindset Strategy

The ANOVA tests was used to know the effects of the growth mindset strategy (providing affirmation prompts vs. without affirmation prompts on worked example worksheets) on transfer abilities, cognitive loads, and math anxieties consecutively.

Transfer Abilities

For the near-transfer abilities, the growth mindset strategy presents the results F(3.124) = 1.106, MSE = 6.244; p = 0.295; $\eta_p{}^2$ = 0,009, while for the far-transfer abiities, the growth mindset strategy F(3.124) = 0.492; MSE = 1.674; p = 0.448; $\eta_p{}^2$ = 0.004. These statistics show that there is no significant effect of growth mindset affirmation both in the near-transfer and far-transfer scores.

Cognitive Loads

For the near-transfer cognitive load ability test, the growth-mindset strategy gives the following results: F(3.124) = 0,012; MSE = 0.041; p = 0.912, $\eta_p{}^2$ = 0.000, while for the far-transfer cognitive load test, the growth-mindset strategy F(3.124) = 0.001; MSE = 0.004, p = 0.970; $\eta_p{}^2$ = 0.000. These results show that there is no significant effect of growth mindset affirmation on cognitive load level both in the near-transfer and far-transfer.

Math Anxieties

In terms of math anxieties, the statistics for the math-anxiety learning show that F(3.124) = 0.580; MSE = 0,893; p = 0.448; $\eta_p{}^2$ = 0.005, while the math anxiety evaluation F(3.124) = 2.306; MSE = 5.709; p = 0.131; $\eta_p{}^2$ = 0.018. These results also show that there is no significant effect of growth mindset affirmation on math anxiety levels.

Main Effects: Learning Strategy

The same analyses were conducted to know the effects of the learning strategy (with worked examples or problem solving only) on transfer abilities, cognitive loads, and math anxieties.

Transfer Abilities

For the near-transfer abilities, the learning strategy gave the following results: $F(3.124) = 1.833$; $MSE = 6.213$; $p = 0.176$; $\eta_p{}^2 = 0.015$, while for the far-transfer abilities $F(3.124) = 2.417$; $MSE = 8.222$; $p = 0.123$; $\eta_p{}^2 = 0.019$. This shows that there is no significant difference between worked example or problem solving in the near-transfer and far-transfer score.

Cognitive Loads

For the cognitive load near-transfer test abilities, the growth mindset strategy gave the following results: F(3.124) = 0.012; MSE = 0.041; p = 0.912; $\eta_p{}^2$ = 0.000, meaning that there was no significant difference effect of instructional strategy on cognitive load level during near transfer. Whereas for the far-transfer cognitive load, F(3.124) = 7.356; MSE = 22.697; p = 0.008; $\eta_p{}^2$ = 0.056, meaning that there was significant difference effect of instructional strategy on cognitive load level during far transfer. Tabel 2 depicts that the expertise reversal effect of the worked example, where students in the worked example group experienced higher cognitive load than the problem solving only group.

Math Anxieties

For the learning math anxieties level, F(3.124) = 4.424; MSE = 6.817; p = 0.037; $\eta_p{}^2$ = 0,034, meaning that there was a significant effect of instructional strategy on anxiety level. Table 3 described those students in the worked example group experienced higher anxiety than the problem solving only group. This does not occur for the evaluation math anxieties level F(3.124) = 0.914; MSE = 2.263; p = 0.341; $\eta_p{}^2$ = 0.007.

Interaction Effects of Growth Mindset Affirmation and Learning Strategy

The ANOVA(s), were conducted on transfer abilities, cognitive loads, and math anxieties and indicated no significant interaction effects overall.

Transfer Abilities

In terms of the near-transfer abilities, the interaction between the growth mindset interaction strategy and learning strategies gave the results F(3.124) = 0.010; MSE = 0.058; p = 0.920; $\eta_p{}^2$ = 0.000, while the far-transfer F(3.124) = 0.296; MSE = 1.007; p = 0.587; $\eta_p{}^2$ = 0.002. This shows that there is no significant interaction effect found between the growth mindset strategy and learning strategies in the near-transfer and far-transfer abilities.

Cognitive Loads

For the cognitive load near-transfer ability test, the growth-mindset strategy gave the following resuts: F(3.124) = 0.241; MSE = 0.726; p = 0.664; $\eta_p{}^2$ = 0.002, while for the cognitive load far transfer F(3.124) = 9.095, MSE = 0.292; p = 0.759; $\eta_p{}^2$ = 0.001. This shows that there is no significant interaction effect found between the growth-mindset strategy and learning strategies in the cognitive load near-transfer test and cognitive load far transfer test.

Math Anxieties

For the learning math anxieties, the learning strategy gave out F(3.124) = 0.270; MSE = 0.417; p = 0.604; $\eta_p{}^2$ = 0.002, while the evaluation math anxieties F(3.124) = 2.555; MSE = 6.326; p = 0.112; $\eta_p{}^2$ = 0,020. These results show that there is no significant interaction effect found between the growth-mindset strategy and learning strategies in the learning math anxieties and evaluation math anxieties.

Correlation for Transfer Ability, Cognitive Load, and Math Anxiety

Table 4 provides the correlation for transfer ability, cognitive load, and math anxiety. The correlation(s), were conducted on transfer abilities, *cognitive loads*, and math anxieties and indicated significant overall.

Transfer Ability and Cognitive Load

Table 4 shows that the transfer test score (near and far transfer test) has a negative correlation with cognitive load (cognitive load near and far transfer test). These meanings that transfer ability tend to be higher when cognitive load is lower.

Transfer Ability and Cognitive Load

Table 4 shows that the transfer test score (near and far transfer test) has a negative correlation with math anxiety (learning and evaluation math anxiety). These meanings that transfer ability tend to be higher when math anxiety is lower.

Cognitive Load and Math Anxiety

Table 4 shows that the cognitive load (cognitive load near and far transfer test) has a positive correlation with math anxiety (learning and evaluation math anxiety). These meanings that cognitive load increases as math anxiety increases. In addition, math anxiety (both during learning and evaluation) were highly correlated with each other, suggesting that they may reinforce each other.

Near transfer score and far transfer score shown a positive correlation with $r = 0.590$, $p < .01$, meaning there is a significant and moderate positive correlation. Participant who perform well on near transfer test also tend to perform well on far transfer test.

Discussion

Effects of Growth-Mindset Strategy on Transfer Abilities, Cognitive Load, and Math Anxieties

On transfer abilities, either near-transfer abilities or far-transfer abilities, positive affirmation in this study does not give significant effects. This finding is oppositive to the study of Blackwell et al. (2007) who state that the *growth-mindset* strategy is effective in improving learning achievements. It is suspected that positive affirmation, as one of the growth-mindset strategies, is not directly related to the development of the cognitive strategies needed for transfer abilities and math anxieties. One who is given positive affirmation may feel more confident on oneself; but this does not always mean that one is more able to use one's knowledge one has learned to solve a problem. This means that learners who are given affirmation may feel confident about themselves, but this does not ensure that they will be able to use their knowledge to sole problems they face. This is because positive affirmation functions more to increase self-condidence and motivation, but it is not directly related to the ways one processes information or overcomes more specific anxieties. Meanwhile, a transfer ability is one which involves cognitive skills that are complex such as understanding relations among concepts or applying knowledge in different contexts which may not be adequate enough to be influenced by the improvement of self confidence and motivation alone. This finding supports Glenberg (1997) who stated that transfer abilities are more influenced by deep understanding and clear relations among concepts in problem solving, rather than merey improving one's self confidence or other positive emotions that are acquired through positive affirmaton. So, transfer abilities need deeper cognitive mastery, not merely motivation supports.

In addition, positive affirmation is assumed to have temporary effects, which means that the benefit of positive affirmation is often limited to a short duration or needs certain specific conditions to give effects significantly. This has been strengthened by Critcher et al. (2010) who found that affirmative effects tend to be temporary and need the appropriate time to give a maximal benefit. When used in inappropriate contexts, the effects will weaken quickly. This is supported by results of the study by Cohen & Sherman (2014) that show that positive affirmation can decrease psychological threats, but it can also revert learners' attention from the main learning focus, more specifically when the affirmation is not directly related to the instructional task.

The effect of positive affirmation is how one looks at one's surroundings, whether or not the environment is seen as a threat or a comfortable place. If one feels psychologically threatened, all mental resources will be focused on how to avoid and protect oneself from the unfriendly surrounding instead of adapting or learning new things to solve the problem. As a result, the working memory capacity, which is initially intended for processing information that is relevant with the learning objective, is used up for managing the threat. Consequently, such threat that can often become a motivation to make positive changes has often obstructed the learner from adapting to confront the situations. This finding is in line with results of the study by Wood et al. (2009) that stated that positive affirmation may give a person a bad effect, more paticularly with one with a low self-confidence. In this case, positive affirmation, which is intended to support learners' self-confidence, has instead become a pressure for them to always think positively; and this may make learners fail to satisfy the standard requirements. This may not give the benefit to be better learners than the ones who are not given the positive affirmation treatment.

For the cognitive loads, near-transfer and far-transfer ability tests, positive affirmation does not contribute significant effects. This finding is in contrast with that of Schmeichel & Vohs (2009) dan Sherman & Cohen (2006) that state that one can use the working memory capacity optimally which has the implication of the decrease of cognitive loads. This is thought to be the fact that more-knowledgeable learners have acquired an adequate knowledge scheme to tackle a transfer-ability test. More-knowledgeable learners tend to have strong and automatic knowledge schemes in certain domains that make it possible to easily make transfers without the help of additional motivation in both the near-transfer and far-transfer ability tests. Self-confidence in adequate mathematics proficiency in more-knowledgeable learners make them not need positive affirmation to manage transfer tasks so that effects of positive affirmation on their transfer abilities are kept minimum. In other words, for more-knowledgeable learners, positive affirmation may not be relevant for them because they are already able to use their acquired knowledge effectively without the support of additional motivation.

Effects of Learning Strategies on Transfer Abilities, Cognitive Loads, and Math Anxieties

Results of the test analyses showed that learning strategies have significant effects on the cognitive load far-transfer ability test and learning math anxieties. In the post-hoc test results, it is known that learners with problem solving experience a lower cognitive load far-transfer ability test than learners with worked example. This finding consistently supports the study by (Kalyuga et al., 2003)) that state that more-knowledgeable learners get a larger benefit through the problem-solving learning strategy which makes it possible for them to better develop their knowledge structure than being burdened by superflous knowledge from the worked example. The study by Renkl et al. (2004) also strengthens this that dissipating the worked example to lighten the problem solving will give better results, especially for more-knowledgeable learners; this means that, for more-knowledgeable learners, who have acquired adequate knowldge for problem solving, problem-solving learning is more beneficial in line with their cognitive capacities. (Sweller et al., 2011b) has also synthesized much research showing that problem solving is highly useful for more-knowledgeable learners because it obviates excessive cognitive loads in receiving redundant learning supports, in this case, the many steps provided in the worked example that, principally, have been acquired by learners.

For math anxieties, results of the statistical tests in this study show that learners who work using problem solving experience lower math anxieties than learners who work using worked examples. In other words, the problem solving learning strategy gives learners larger benefits in the form of low math anxieties than does the worked example learning strategy. In this study, the participants were more knowledgeable. This was supported by information from the teacher that the students had learned relevant mathematical topics, namely line and angles in previous lessons. The teacher reported that the students had completed the classwork and assessments on this topic before the study took place. (Kalyuga, 2007) explained that students have prior experience and familiarity with the learning domain. Thus, it can be said that the participants in this study are more knowledgeable learners.

More-knowledgeable learners have an adequate knowledge scheme in their long term memory so that they tend to not have worries that cause anxieties on the knowledge they have when confronted with instructions related to the instructional tasks they need to carry out. The worked example, which contains guides to finish the tasks that lead novice learners to focus on the knowledge construction, turns out to tarnish the more-knowledgeable learners. The more-knowledgeable learners who have acquired an adequate knowledge scheme saved in their long term memory and receive infomation through the worked example, where the two pieces of information are principally the same, are urged to match and integrate the two to form a new knowledge scheme. This process, which consumes much working memory capacity and is not relevant with the learning objective, causes an extraneous cognitive load to occur. It is this process that may cause anxieties if the activity of matching and integrating fails to work out. Meanwhile, more-knowledgeable learners who work using the problem solving strategy only need to use the knowledge scheme they have for processing the tasks so that self-confidence arises that they are able to complete them and this causes them to experience a minimal math anxiety to complete the task.

Interaction Effects of Growth-Mindset Strategy and Learning Strategy

Results of the test analyses show that there is no interaction between the growth mindset strategy and learning strategy for all the dependent variables in the study. In other words, the growth-mindset strategy does not influence the learning strategy in the cases of the transfer-ability test, cognitive loads, and math anxieties. This is assumed to be the results of the adequate availability of knowledge schemes in the more-knowledgeable learners to overcome various situations they face in the transfer ability test, cognitive loads and math anxieties. The more-knowledgeable learners tend to have the adequate knowledge schemes saved in their long term memory which make it possible for them to process information and apply their knowledge efficiently. It is why, either learning strategy, worked example, or problem solving has a significant effect. Sweller (1988) also shows that the effect of the learning strategy, which decreases cognitive loads and, so, pushes transfer ability has effects more on less-knowledgeable learners than more-knowledgeable learners.

Besides, positive affirmation that is used in the present study is supposed to not give a large effect on the more-knowledgeable students. The availability of adequate knowledge schemes in more-knowledgeable learners give them high self-confidence of their abilities to be successful. Statements by Dweck (2015)) strengthen this assumption that interventions based on growth mindset tend to be more effective for learners who do not have a high self-confidence or who experience difficulties in learning. In other words, positive affirmation, as one of the growth-mindset strategies, does not give additional benefits to more-knowledgeable learners because they have the positive mindset of their abilities to be successful.

The ceiling effect is suspected to be the reason for the absence of interactions between the learning strategy and growth-mindset strategy, wherein more-knowledgeable learners have performance that is nearly maximal so that there is not much space for further correction. When learners have achieved a high performance, additional influence from learning strategies or positive affirmation is difficult to measure because the effect may be too small to detect or, even, inexistent. This assumption is strengthened by (Chi et al., 2009) who state that more-knowledgeable learners can often reach a performane level that is nearly optimal so that the differences among learning strategies or other interventions are not observable.

Based on the discussion above, it can be stated that the absence of interactions between the growth-mindset strategy and learning strategy in the present study is due to the nature of the more-knowledgeable learners. The availability of adequate knowledge schemes in the more knowledgeable learners make them feel to have a high self-confidence for success so that they do not need additional supports nor particular learning strategies to be able to complete the transfer ability test. Besides, more-knowledgeable learners tend to be able to manage cognitive loads and math anxieties better so that, in the present study, cognitive loads and math anxieties in the research groups do not show significant differences.

Correlation Transfer Ability, Cognitive Load, and Math Anxiety

The findings demonstrate that higher transfer ability, both near and far, is significantly associated with lower cognitive load and lower level of math anxiety. These results suggest that students who experience less mental strain and reduces emotional distress are better equipped to apply learned knowledge in both familiar and novel problem contexts. This aligns with Cognitive Load Theory (Sweller et al., 2011a), which posits that when extraneous and intrinsic cognitive loads are minimized, learners can allocate more working memory resources to processing and applying information, facilitating more effective transfer of learning. Additionally, math anxiety, which is known to interfere with cognitive functioning, appears to further amplify cognitive load and reduce performance (Ashcraft et al., 2007). The presence of anxiety consumes attentional resources and working memory, leaving less capacity available for problem-solving and transfer tasks (Ramirez & Beilock, 2011).

Moreover, the analysis relevance that cognitive load significantly increases alongside elevated levels of math anxiety, both during learning and evaluation. This supports that math anxiety actively impairs learning by increasing the perceived mental effort required to complete tasks or mathematics performance (Klados et al., 2019; Maloney & Beilock, 2012). Students with higher levels of math anxiety may perceive tasks as more difficulty than they actually are, due to the intrusive thoughts and heightened emotional arousal that accompany anxious states. This perceived difficulty manifests as increased cognitive load, which in turn may hinder task performance and knowledge transfer.

In summary, the data underscore the interrelated nature of cognitive and affective nature of cognitive and affective factors in mathematical learning. Reducing cognitive load and managing math anxiety are essential not only for improving immediate performance but also for enabling long-term transfer of learning. These findings highlight the importance of instructional strategies that are both cognitively supportive and emotionally responsive.

Limitation

The limitation of this study is the research sample for less-knowledgeable was not collected but only the more-knowledgeable sample was collected. In further research, it is possible to add a research sample for less-knowledgeable and more-knowledgeable to find the expertise reversal effect. In addition, this study did not collect data on how participants responded to the growth mindset affirmations of participants' understanding of the contents of the affirmation given, because this study focused on transfer ability, cognitive load, and math anxiety. However, further research can add instruments to explore whether students really understand to contents of affirmation given or not. And the last, the study focuses on independent variables, meaning that the results of this study cannot explain variables other than the variables studied, so if generalized to natural learning situation in the classroom, the results may be different.

CONCLUSION

Positive affirmation which is expected to be able to reduce extraneous cognitive loads of the worked example for more-knowledgeable learners in this study is not found. Positive affirmation as used in this study has not been able to impede the reversal effect of the use of the worked example for more-knowledgeable learners. This is caused by the fact that positive affirmation is not directly related to the needs for supporting transfer abilities and decreasing cognitive loads and math anxieties. Positive affirmation tends to give momentary effects so that, for longer effects, special conditions or treatments are needed, such as adding relaxation exercises. Besides, positive affirmation may contrarily become a psycological threat if it is not given according to the learners' conditions in which positive affirmation may cause the cognitive load to increase. In this case, in future studies, positive affirmation can be given more specifically with the learning objective and, possibly, added with relaxation exercises.

Even though positive affirmation has not yet been found to give significant effects, the present study confirms previous research concerning expertise reversal effects, that more-knowledgeable learners who learn by problem solving show a lower level of cognitive loads than those learning by worked examples. The minimum level of cognitive loads experienced by learners also cause ,ini,um levels of math anxieties. The present study can thus be said to expand generalizations of the expertise reversal effects that have previously been found.

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