New SCAMPERS: Reclassifying and redefining thinking skills

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Abstract

It has long been known that the SCAMPER checklist is a useful tool for developing creative thinking. However, the meanings of some words might change based on the different interpretations of the users. Here we aimed to reorganize this model to avoid placing different thinking directions into the same category. We designed a new checklist, including Substitute, Combine, Adjust, Modify, Permute, Eliminate, Repurpose, and Size, and renamed it NEW SCAMPERS. Using a questionnaire, we tested the participants' understanding of the checklist's meanings and its application. We recruited 194 students from three campuses and analyzed 191 completed answers. We found that students can comprehend the new classified category, and most do well on the application inspection. Thus, the new checklist was proven to be an appropriate technique for group creative thinking.

Keywords: Creative thinking, checklist, SCAMPER, Bloom's Taxonomy, thinking skill.

1. Introduction

It is widely accepted that creativity can help us to find useful and original ideas when we encounter problems or complicated situations. Marakas (2003) proposed that creativity is an important element when attempting to do old things in new ways. Creativity can also be used to find methods to do things not yet discovered. Creativity can also guide us to new directions when we attempt to solve complex problems. Robinson and Azzam (2009) advocate that creativity should be a creative process that generates original ideas with value. Creativity can be applied to any activity and is a creative process that stimulates fresh ideas and imaginative insights. Beside producing novel ideas, creativity is also related to innovation. West, Sophie Chang, and Sacramento (2006) describe innovation as a cycle with two major components; creativity is the beginning of the cycle (dedicated to developing new ideas), which is followed by ideas implementation. Creativity plays an important role in the early stages of innovation.

Creative thinking techniques are useful for stimulating idea production. Individuals who have a list of ideas will generate more problem solutions than those without a checklist. The idea checklist technique has long been adopted to enhance creativity. Osborn's checklist is well-known as a means of prompting someone's creative thinking. Osborn (1963) proposed the concept that increasing the number of ideas will also increase the quality of ideas produced. Osborn also suggested separating idea generation from idea evaluation. Osborn brainstorming appraoch is a group thinking method to help people develop new ideas and share them with team members during the problem-solving process.

Osborn (1963) developed 73 Idea-Spurring Questions as a trigger list to stimulate ideas. This means that if we ask different questions about a problem, we can retrieve from our memory and generate brilliant ideas because we evaluate from different aspects. B. Eberle (1972) simplified Osborn's list into the acronym SCAMPER. Osborn designed SCAMPER games to arouse children's curiosity. SCAMPER remains popular in incubating divergent concepts. This idea-generating technique has been applied to multiple fields. Some researchers applied SCAMPER to creative training and enhancing creative thinking skills (Çelikler & Harman, 2015; Ritter & Mostert, 2017; Suciu, 2014). SCAMPER has also contributed to developing a curriculum for improving the imagination in the technology commercialization process (Huang, Kao, Lu, & Wu, 2017). In the engineering design field, SCAMPER is employed to measure the influence of the design outcome when applying different design methods (Chulvi, González-Cruz, Mulet, & Aguilar-Zambrano, 2013; Chulvi, Mulet, Chakrabarti, López-Mesa, & González-Cruz, 2012). Computer Science is another field that has adopted this approach. Seltani, Aknin, Amjad, Chrayah, and Eddine El Kadiri (2016) utilized the SCAMMPERR method to elaborate the collaborative process of decision-making. Teixeira and Maccari (2014) compared the bench-marking and innovation processes in building the prototype of an Alumni Portal.

SCAMPER refers to the first letter of seven categories: Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, Reverse, and Rearrange. Because the SCAMPER technique has been exploited to fit many circumstances, different investigators might have disparate views of the acronyms' meanings. Gradually, SCAMPER has been extended with other verbs to replace its original meaning. For instance, the letter A could be Adapt or Adopt. M might represent as Modify, Magnify or Minify. We propose that it is necessary to reorganize these verbs and to place them into suitable categories. Therefore, this study tends to integrate different SCAMPER verbs and meanings to create a new classification. These categories should retain the features of being easy to memorize and having a strong connection to the category meaning.

1.1 Evolution of SCAMPER

As an advertising executive, Osborn invented the brainstorming method and outlined detailed procedures, which were used to generate potential solutions for specific problems. There are four phases of this technique: idea generation, idea compilation, idea evaluation, and idea selection (Isaksen & Gaulin, 2005). In the first phase of idea generation, Osborn assumed that quantity would consequently breed quality; generating more ideas will increase the chance of producing a divergent and efficient solution. Therefore, Osborn created idea-spurring checklists to induce participants to suggest ideas and solutions by asking questions related to the issues being discussed (Bonk & Smith, 1998). Osborn's idea checklist involved asking team members to look at things from a radical perspective. The listing questions could be divided into nine suitable categories: 1. Put to other uses; 2. Adapt; 3. Modify; 4. Magnify; 5. Minify; 6. Substitute; 7. Rearrange; 8. Reverse; and 9. Combine (Marakas, 2003). B. Eberle (1972) developed games intended for use by youngsters and revamped Osborn's 73 spurring questions into seven categories, which he named SCAMPER: Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, and Rearrange. If we examine the model, we can see Eberle added the Eliminate element to the original technique, clarified R to be Rearrange, and reduced M to be just Modify. For several years, SCAMPER was acknowledged as a

useful method for developing creative thinking and producing appropriate suggestions. Michalko (2010) revised the model and renamed the approach SCAMMPERR, which includes: Substitute, Combine, Adapt, Magnify, Modify, Put to other uses, Eliminate, Rearrange, and Reverse. This checklist synthesizes Osborn and Eberle's models into nine categories. Hanesova (2014) utilized SCAMMPERR in Content and Language Integrated Learning (CLIL) to guide students to see complexity through deeper thinking. The method actually brings CLIL students fanciful new ideas. Seltani et al. (2016) combined Web 2.0 with SCAMMPERR in the collaborative decision-making process, which helps users and developers easily and quickly create a new web application. This proved to be a very powerful technique and was named SCAMMPERR 2.0.

1.2 Divergent explanation for SCAMPER

Since B. Eberle (1972) introduced SCAMPER to children's divergent thinking training, the method has been tested on subjects from 3-years-old to college students. Later, Eberle designed the Light Bulb Game, which uses lots of spurring questions to stimulate the imagination. Originally, SCAMPER stood for Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, and Rearrange. However, after some tests on participants, Bob Eberle (1977) adjusted SCAMPER to include nine meanings, where (Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)(Ulger, 2016)("Intelligence and Creative Competitive Intelligence,")S stands for Substitute, C for Combine, A for Adapt, M for Modifying, Magnify, and Minimize, P for Putting to other uses, E for Eliminate, and R for Reverse and Rearrange. Some researchers gave multiple connotations to each letter. Burke (1994) uses A as Adapt and Adopt and E for Erasing, Eliminate, and Elaborate; whereas Goria (2017) defines M as Modify and Magnify, which including the meaning of amplifying, enlarging, and extending. Rule (2015) states that R referrers to Reverse and Reorganize. Chulvi, Sonseca, Mulet, and Chakrabarti (2012) proposed that R should stand for Reordered and Invert. For Eberle's definition, P stands for Put to other uses, whereas other researchers use Purpose or Repurpose as a replacement (Gobble, 2014; Ritter & Mostert, 2017). Because most researchers agree the S should stand for Substitute and C for Combine, here we only addressed the remaining five letters (Table 1).

Table 1   Letter meaning of SCAMPER (S for Substutute, C for Combine)

A	M	P	E	R
Adapt	Modify	Put to other uses	Eliminate	Rearrange(Reorder)
Adopt	Magnify(Maximize)	Purpose; Repurpose	Erase	Reverse(Invert)
Amplify	Minify(Minimize)		Elaborate	Revert
				Reorganization

We found it is necessary to reclassify SCAMPER into proper categories. For example, M has three meanings: Modify, Magnify, and Minify. However, it is not suitable to put these together because Modify means to change the original item in form, shape or color, but Magnify and Minify mean to make the original item larger or smaller. Amplify could also be added to this category. A has two meanings, Adapt or

Adopt. Adapt means to adjust to suit a purpose or condition (Glenn, 1997). Adopt means to get ideas from other things, process or thoughts to make something one's own (Buser, Buser, Gladding, & Wilkerson, 2011). P stands for Put to other uses. Ritter and Mostert (2017) proposed that P stands for Purpose, meaning to put a product or process to another use. Gobble (2014) even suggested Repurpose as the true meaning here. E stands for Eliminate. Burke (1994) added Erase and Elaborate to this category. Erase means to subtract something. Chen, Liu, Hsu, and Lin (2010) expressed E as to Eliminate, remove or simplify; which is similar to reducing elements from the object we are working on. Elaborate means to refine and evaluate ideas to improve an object, which is also linked to the concept of elimination. R stands for Rearrange and Reverse. Rearrange means to change the sequence of operations or any other hierarchy of an object (Ritter & Mostert, 2017). Reorder (Chulvi, Sonseca, et al., 2012) or reorganization (Rule, 2015) seems linked to the concept of rearranging. Reverse means to change the direction or orientation, making an object go backward, turning something inside-out or upside-down (Serrat, 2017). Revert (Teixeira & Maccari, 2014) or invert (Chulvi, Sonseca, et al., 2012) have similar meanings as Reverse.

2.Reclassification

According to the above discussion, we attempt to use words with a broader meaning to extend the range of thinking directions and contain the original meaning of SCAMPER. Therefore, we kept most of the checklist verbs, but move some verbs to other categories. First of all, we retain S for Substitute and C for the Combine. In the letter A area, we use a new word, Adjust, to include adapt and adopt, whereas Amplify is switched to the Magnify item. For letter M, we retain Modify and transfer Magnify and Minify to a new category, named Size, represented by the letter S. For the letter P, we keep the original meaning, Put to other uses, but simplify it to the word Repurpose. For the letter E, we maintain Eliminate as the core meaning, but also Erase and Elaborate are integrated into the same category. Instead of the letter R, we use a letter P to represent the word Permute, which is an umbrella term that includes the meanings of Rearrange, Reverse, Revert, and Reorganization. As a new classification of SCAMPER, we proposed a NEW SCAMPERS to encompass the above meanings (Table 2).

Table 2 Definitions of NEW SCAMPERS

Operators	Definitions
Substitute	Replace components, materials, and elements of the objects or processes
Combine	Mix or integrate items and elements of subject matter toward a solution
Adjust	Adapt elements, change features to fit a specific condition or purpose Adopt ideas from other things to make progress on the current issue
Modify	Revise attribute forms to improve the conditions of the object
Permute	Change the sequence of operations or any other hierarchy of the object Change the direction or orientation; turn the thing inside-out and upside-down
Eliminate	Remove, simplify, and subtract elements or processes of the subject matter

| Repurpose | Use the item for some other purpose, beyond its original intention |
| Size | Magnify or minify the form, time, attributes, and elements |

3. Conceptual schema understanding tasks

Much work has shown that idea generation is related to the former knowledge stored in the brain. Smith, Herbein, and Morris (1999) found that the idea-generating process must broaden one's perspective of knowledge and integrate many fields of accepted knowledge. Paulus and Brown (2007) discovered that new ideas are produced by relevant knowledge from memory, and combine diverse aspects of stored knowledge into fresh ideas.

Markman (2015) claimed that bring existing knowledge to support a new problem or goal is the key element of creativity. To solve new problems, it is important to find the relevant information from your memory. From classroom observation, Radziszewski (2017) gained found that SCAMPER depends on clues to assist students with associating ideas from various domains of knowledge. The technique also pushes students to make the connections between concepts of the current issue's knowledge domain, and other fields aid them to reach a moderate level of originality.

Burton-Jones and Weber (1999) asserted that when dealing with a problem, the settlers depend on getting knowledge from a schema when they have access. These authors show that applying domain knowledge in the conceptual schema is important. Burkhardt, Détienne, and Wiedenbeck (2002) regarded schema understanding tasks as read-to-do (with access to the schema) or read-to-recall tasks (without access to the schema). Bodart, Patel, Sim, and Weber (2001) found that chunked knowledge stored in our memory could be reused in the proper situation. Conceptual schema understanding needs problem solvers to answer questions concentrated on surface-level understanding. Therefore, our research examined the conceptual schema understanding task by testing subjects' comprehension and application of reclassified checklists. The researcher also adopted Bloom's Taxonomy to evaluate students comprehension and application of the new checklist(Bloom, 1956).

4. Method

This study begins with a literature review of the checklist technique, which includes surveying the theoretical framework related to the topics. The purpose of this step is to trace the developing history of SCAMPER. The second step is to analyze every acronym meaning of SCAMPER, thereby identifying opportunities for potentially different interpretation. In the third step, we classify every letter meaning of SCAMPER and add them to the appropriate categories. The fourth step is to suggest a new classification of this checklist technique. Finally, we adopted conceptual schema understanding tasks and designed a questionnaire to evaluate subjects' comprehension and application related to NEW SCAMPERS.

4.1 Study Design

To assess the appropriateness of the new SCAMPER checklist, we used a questionnaire consisting of two parts; the first part is to measure if participants understand the operator's vocabulary meaning. The second part is to measure if participants could comprehend the meaning conveyed in the acronym, and could distinguish every single category and the application of this new classification. Before the participants completed the questionnaire, a 10-min PowerPoint presentation of NEW SCAMPERS was given by the researcher, which explained the letter meaning of the acronym, and to demonstrate how to apply the NEW SCAMPERS techniques using actual products as a demonstration and letting the subjects know the usage situation of the method. Following the presentation, the participants completed a 2-page questionnaire. No guidance was given during the testing period.

4.2 Participants

One-hundred-ninety-four college students were recruited from National Pingtung University to participate in this study. The participants were enrolled in courses during the summer session of 2018, two of them are graduate-level courses, the other three are college-level courses. Students were provided an option to join the evaluation. Most participants were female, and the mean age of subjects was 21 years (range, 17 to 50). The participants came from a variety of departments, separated from some different major but not declared intentionally.

4.3 Research Instruments

The questionnaire was developed by the definition statement of NEW SCAMPERS; it started with demographics, including gender and age of the subjects. The second part offers eight questions to probe their understanding of comprehension of this checklist. Each question contained one or two sentences describing a verb related to a certain method, followed by eight choices (one correct and seven incorrect answers). The third part was formed of eight questions to measure the participants' understanding of the application of this checklist. Each question contained a narrative statement regarding the application of a specific letter, followed by eight choices (one correct and seven incorrect answers). The last part aimed to determine the proportion of participants that acquainted with this checklist technique and to rank the methods for how easy they were to apply.

Table 3 Evaluation of syntactic knowledge of the checklist

Operators	Statements
Substitute	If we could find a way to replace the old function or find a new material
Combine	If we could integrate two items or functions together
Adjust	Change some parts to fit the situation, or employ some ideas to current issues
Modify	Revise original materials, functions, and outlook to improve the object
Permute	Change the sequence of parts and directions, or regroup the object
Eliminate	Remove or reduce functions, simplify materials or content of the object
Repurpose	Beside the current function, could we find some other uses for the object
Size	Check the effect when enlarged, partly zoomed out or viewing the whole of the object

Table 4 Evaluation of semantic knowledge of the checklist

Operators	Statements
Substitute	Use sugarcane fiber straws rather than disposable plastic straws
Combine	Swivel chair is made by integrating chair legs and wheels
Adjust	Japanese standing noodle restaurant in Taiwan put stools for the customer to sit
Modify	Change the way of pulling out easy can, make ring-pull to sink immediately
Permute	Vacuum cleaner sucks the dirt; leaf blower machine blows the leaves
Eliminate	iPhone eliminates the need to press a button; just touch the screen
Repurpose	Us ed tires can be used as swings in a park's playground
Size	Inflatable yellow Rubber Duck designed by Hofman floating in the harbor

4.4 Data Collection

The researcher conducted this study by oral explanation before data hand out. Some written statements were sued to assist participants in answering the questions. The questionnaire was distributed to students at the Minsheng, Linshen, and Pingshang Campuses of National Pingtung University. The students from various courses completed the form voluntarily. The research aim was revealed at the beginning of the investigation. No specific identifying data were requested, but the students were asked to provide gender and age, which could be used to analyze the relationship between checklist item and demographics. It took about 30 min to finish the whole survey. No compulsion was made to the students, they returned the questionnaires freely, including complete and incomplete forms.

4.5 Data Analysis

Data were coded and analyzed using SPSS (Statistical Package for the Social Sciences, version 19.0). Descriptive statistics such as frequencies, percentages, and means were used to summarize the characteristics of participants and the scores obtained in the NEW SCAMPERS checklist. In total, 194 respondents completed the questionnaires, of which three left insufficient personal information and were, therefore, excluded from the sample. Ultimately, 191 students with completed answers were analyzed by the researcher. The respondents included 53 males and 138 females, between 17 and 50-years-old (45% below 20-years-old and 46.6% 20–25-years-old).

5. Result and Discussion

After the oral presentation and the paper statement of the NEW SCAMPERS, almost all of the respondents understand the surface level meaning of this new checklist (Table 5). We found that 100% of the participants understood Combine, Permute, and Repurpose. Eliminate and Size were understood by 99.5% of participants, and the remaining classifications (Substitute, Adjust, and Modify) by 99%. These results show that the students who participated in the test were acquainted with the meaning of the NEW SCAMPERS. Thus, the respondents could comprehend the technique after a short explanation of the

checklist. The participants understood every definition of the new checklist, and are ready to get the next step; they prepared sufficiently before shifting to application.

Table 5 The Comprehension of NEW SCAMPERS

	Correct Rate of Comprehension(%)							
Operators	Substitute	Combine	Adjust	Modify	Permute	Eliminate	Repurpose	Size
	99	100	99	99	100	99.5	100	99.5

Based on application stage, approximately 70% could recognize every classification of this new checklist. Size 97.9% is the highest, followed by Permute 92.7%, with Repurpose in third (90.1%). Combine 89.0%, Adjust 88.0%, Modify 80.1% reaches the eighty level. Substitute 79.1%, very close to eighty percent. The lowest is Eliminate 69.6%, about seventy percent (Table 6). In Eliminate item; there is 69.6% participant judge the right category of the checklist, however, still 22.0% of students choose to Modify as the answer. Probably lack of experience is hard to get that kind of knowledge. Semantic knowledge is also involved in information exchange.

Table 6 The Application of NEW SCAMPERS(%)

Correct Category		Incorrect Category							
		Substitute	Combine	Adjust	Modify	Permute	Eliminate	Repurpose	Size
Substitute	79.1	——	0.5	6.8	10.5		1.0	2.1	
Combine	89.0	2.1	——	2.6	5.8		0.5		
Adjust	88.0	1.6	0.5	——	6.3	1.0	1.0		1.6
Modify	80.1	3.7		8.4	——	4.7	2.6		0.5
Permute	92.7		0.5	3.1	1.6	——		1.6	0.5
Eliminate	69.6	3.1	1.0	2.6	22.0	0.5	——	1.0	
Repurpose	90.1	2.1	2.1	0.5	3.1	0.5	1.6	——	
Size	97.9	0.5		1.0	0.5				—
									—

The participants expressed their understanding of NEW SCAMPERS definition by evaluating a Likert 5-point scale; the average comprehension score for the meanings of the eight spurring words was 3.92. Participants were also required to reply to the degree that they feel they can apply these words to the creative thinking issues. The group average was 3.76 on five-point Likert scales. This reveals that to comprehend the meanings of thinking skills is easier than to apply those skills to solve real problems. We also investigated which skill the participants considered the easiest method for them to apply to their major field for creativity. The outcome shows that the top three methods that the students choose were Substitute (37.2%), Size (26.2%), and Combine (16.8%). This indicates that to replace something is the easiest approach when engaging in creative thinking. To make things larger or smaller, the rule is also simple for

the students to utilize. Also, bring elements together to create something new is likely very liable for the students to adopt. The Permute technique is the most unlikely skill they will use during the development of their creative thinking. Just 0.5% of students make this method a priority. Therefore, we speculate that it is unlikely that the students will reverse or rearrange something when faced with a problem or situation that needs to be solved. Among the participants, 3.1% choose Repurpose as the best route to achieving creative thinking. In other words, this skill is the second least likely method to come to their mind when developing creativity.

Comparing the comprehension stage and application stage; we found that participants could easily get comprehension of the checklist from oral presentations. The acquisition of comprehension is by way of meaningful learning, and usually under the development of a specific problem. The problem-solving process involves retrieving the related concepts from the long-term memory and combining this with short-term memory information. Therefore, the participants might understand the definition of the eight creative skills, but they might not have the same interpretations when they apply this technique. For students, they judge the creative skills from previous knowledge and experience. On the application stage, the iPhone removes the need for the cell phone button, which is a demonstration of Elimination. However, some students might consider that the button still can be found on the screen, so they choose to Modify as the category.

6. Conclusion

The researcher reviewed many ideas, generating checklists starting from the original inventor Osborn; the related creative thinking techniques were analyzed. This included Eberle's SCAMPER list and Michalko's SCAMMPERR amended checklist. However, it appeared that words with different meanings had been placed into the same category. As a result, those participants involved in creative thinking development might go in different directions, or ignore the other direction within the same category. Therefore, here we reclassified SCAMPER into eight new categories, placing identical words into the same field, which we renamed as NEW SCAMPERS. We hope that this new checklist can guide creative thinkers in a clearly defined manner.

The revised idea spurring checklist was evaluated by comprehension and application of the technique. After verification of the purposed questionnaire, we show that participants understand the definition of the checklist word. Also, most participants could identify the checklist category, and figure out how to stretch these spurring words to the application. Thus, NEW SCAMPERS is a useful tool for stimulating ideas. From the result of the application test, it tells us that the presentation of an overview and examples may not make the participants understand how to practice the technique in real situation. We propose that it is necessary to develop a training program that helps students to explore and apply the model. It is probably a critical successful factor for creativity development before group discussion.

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