



CREATIVITY DIMENSIONS OF INDIVIDUAL AND GROUP WITH THE MODERATING ROLE OF GUIDANCE

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Abstract. The current study intends to explore the effect of a participant unit (Individual/group) and guidance provided through design thinking on different dimensions of creativity. It further discusses the relevance of employing a particular participant unit to get better output based on the requirements at different stages of innovation or creativity. The study explores different aspects of creativity – originality, fluency, flexibility, or elaboration – to determine which is stronger in individual, group, and guided units. The experimental study was conducted with 20 groups and 159 individuals. Non-guided Individuals (students pursuing master's in business administration) made up the control group and the three experimental groups were non-guided groups (students pursuing master's in business administration), guided individuals, and guided groups (students pursuing master's in design thinking). The results show that groups are better in fluency and flexibility whereas individuals are better in originality and elaboration. The role of "group" and "guidance" (degree in design thinking) in innovation, creativity, and idea generation has reverberated in this research. The present study provides insight to researchers, students, and individuals in either academics or corporate interested in creativity and innovation.

Keywords: creativity, design thinking, experimental study, groups, guidance.

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1. Introduction

The complex business environment, digitalization, and social networks require an organization to obsolete the current processes and formulate and implement new processes (Eikhof & Haunschild, 2007; Lampel et al., 2000). In times of innovation, creativity has become the critical competence for the sustenance of the organization as well as the individual (Grant, 1996; Mohrman et al., 2006; Dionne, 2008). Researchers have different views about "creativity and innovation". Some consider them distinct (Černe et al., 2013; Oldham & Cummings, 1996; Reiter-Palmon, 2011; Rank et al., 2004; Stein & Harper, 2012) and others posit that they are related (Paulus, 2002). "Ideas" are the foundation unit of creativity and innovation (Drazin et al., 1999; Mednick, 1962; Woodman et al., 1993). However, idea generation is not a sufficient condition for innovation; rather it requires maturation, challenge, enrichment, and validation of the concept (Birkinshaw et al., 2012; Block & MacMillan, 1993; Christensen & Raynor, 2003; Furr & Dyer, 2014; Govindarajan & Trimble, 2005). The process of innovation has different stages like idea generation; value assessment and project implementation (Teece, 2009). These different stages would require distinct inputs (Joo et al., 2013; Runco, 2009), depending upon the role of a particular creativity dimension at a specific stage. Individuals could be the

actors of creativity who acts based on his/her disposition, domain knowledge, and motivation. It is also realized that “brainstorming”, and “teamwork” are employed to bring in different perspectives. In such cases, “collaboration” becomes the key process for the act of innovation. To further strengthen the “act of creativity” techniques like “guidance” and “instruction” provide effective intervention. The process of idea- generation, and implementation is the source of competitive advantage (Anderson et al., 2004; West, 2002; Zhou & Shalley, 2003), and managing creativity is a challenge for the organization (Cohendet & Simon, 2015).

Creativity and innovation, a critical competence for business, make design thinking a critical deliverable of management education (Boland & Collopy, 2004; Starkey & Tempest, 2009). However, Formosa and Kroeter (2002) found the absence of a design thinking component in the management school curricula, else there is just cursory attention to this, on the other hand, Guaman-Quintanilla et al. (2023) found that the curricula and pedagogy of the masters in design thinking courses stimulate the student to unleash their creative potential. Hence, we intend to explore the differences in the creativity dimensions of the students pursuing business administration courses and design thinking courses. We further aim to understand the creativity levels at different units of analysis i.e., individual and group. We further focus our study on the significance of different processes i.e., individual, group, and guidance at different stages of innovation. The study is based on the Wallach-Kogan test of creativity which analyses the creativity on basis of originality, flexibility, fluency, and elaboration. We propose that the four dimensions of creativity mentioned above differ between individuals and groups; guided and non-guided people. Identifying the source of the creativity dimension would facilitate the efficient processing of the idea from generation to the implementation stage. The earlier studies focused on differences in creativity dimensions of either unit of participants or guidance but not both. Also, no research on creativity explored guidance as “formal learning”. The current research explores both units of participants and guidance as the antecedent variables affecting creativity and considers guidance as the formal learning mechanism.

2. Research questions

- a. Which of the following units yields the highest creativity output on four dimensions of creativity: Individual Creativity (IC), Collaborative Creativity (CC), or guided creativity (GC)?
- b. Does guidance in the form of design thinking degree moderate the relationship between creativity output and unit of participants (Individual Vs Group)?

3. Literature review

Researchers in the creativity field have begun to bridge the gap between innovation and creativity (Benner & Tushman, 2003; Jansen et al., 2006; March, 1991; Mom et al., 2009) and believe that idea-generation is the common construct between the two.

3.1. Creativity

Guilford (1950) and Torrance (1974) are among the first ones to discuss the cognitive variables related to creativity, which was further discussed by researchers as the interaction between

cognitive and affective processes (Finke et al., 1996). Creativity is defined as “the process, outcomes, and products of attempts to develop and introduce new and improved ways of doing things” (Anderson et al., 2014). Some researchers consider that creativity refers to idea generation whereas innovation means the implementation of the idea (Oldham & Cummings, 1996; Rank et al., 2004). The other researchers differ in their approach toward innovation who consider creativity as the first stage of innovation and implementation as the second stage (Paulus, 2002; Amabile et al., 1996; Oldham & Cummings, 1996; Shalley & Zhou, 2008; West & Farr, 1990). Based on this differentiation, scholars argue that creativity is an “intra-individual” cognitive process and innovation is an “inter-individual social” process (Rank et al., 2004).

Creative thinking can be both convergent and divergent thinking (Guilford, 1956; Har- ing-Smith, 2006; Kim, 2006; Sawyer, 2006; Kaufman & Sternberg, 2007; Simonton, 2004; Dia- mond et al., 2007; Vandervert et al., 2007). Cropley (2006) defined convergent thinking as “the ability to apply conventional and logical search, recognition, and decision-making strategies to stored information to produce an already known answer” and divergent thinking as “the ability to produce new approaches and original ideas by forming unexpected combinations from available information and by applying such abilities as semantic flexibility, and fluency of association, ideation, and transformation”. Divergent thinking involves exploring different ways and finding novel alternatives for problem-solving whereas convergent thinking con- verges all alternatives into a single solution (Guilford, 1967). The product of creativity should be new, relevant, and useful (Kharkhurin & Samadpour, 2008).

Guilford (1967) further discussed the parameters for assessing creativity which included: fluency (generating the number of ideas or solutions to a problem); flexibility (considering different approaches to problem-solving); elaboration (detailing of the idea); and originality (generating unique ideas).

Innovation can occur at different levels. It may happen at the individual, team, organi- zational level, or combination. For this study, we consider two levels: individual and group. Further, the study also delves into finding the impact of guiding on creativity. Some research- ers believe that creativity differs between groups and individuals (Hirst et al., 2009) whereas some differences in their approach claim that there is no difference in the creativity between a group and an individual (Banghart & Sparker, 1963).

3.1.1. Individual level

The researchers believe that creativity is the personal disposition (Zhou & Hoever, 2014) like biographical conditions, cognitive style, and ability and personality – and is further affected by domain knowledge; Motivation; social influences, and contextual influences (Amabile & Pillemer, 2015). Every individual has a certain level of creativity based on one’s sense-making ability, motivation and knowledge, and skills (Kaufman & Beghetto, 2008; Sharma, 2015).

Some researchers who study the individual as the creative unit, have discussed personality traits (Gong et al., 2012); other personal dispositions like self-concepts (Tierney & Farmer, 2011); positive psychology (Amabile et al., 2005; Rego et al., 2012); behavioral aspects related to creativity (Zhang & Bartol, 2010) and consider that creative thinking is affected by these personal dispositions of an individual. Some researchers also focus their study on contrasting individual-level creativity and group or team-level creativity (Tierney & Farmer, 2002; Tadmor

et al., 2012). Originality (Kohn & Smith, 2011; Grant, 2016; Markman, 2017) and fluency (Diehl & Stroebe, 1987) dimensions of creativity are better in individuals than groups. The individual's personality, motivation, domain knowledge and skill affect creative thinking.

3.1.2. Collaborative level

The extant literature discusses groups and group behavior (Bazerman et al., 1984; Janis, 1972, 1982; Jervis, 1976; Staw, 1981; Tuchman, 1984) and has used terms like "risky shift", "selfish shift" and "cautious shift" (Forsyth, 1990; Shaw, 1976). The groups tend to exhibit the decisions to be average of group opinion confirming the group shift. Similarly, group think (Bazerman et al., 1984; Janis, 1972, 1982; Jervis, 1976; Staw, 1981; Tuchman, 1984) relates to a group's tendency to follow the decision despite being disadvantageous. The concept of "group think" and "group shift" is based on social comparison theory (Levinger & Schneider, 1969). The theoretical aspects discussed above indicate that the originality (Kohn & Smith, 2011; Grant, 2016; Markman, 2017) and fluency (Diehl & Stroebe, 1987) of individuals would be better than the groups.

The role of group interactions and brainstorming in creativity is discussed in the literature (Simonton, 1975; Sawyer, 2006; Osborn, 1953; Kamylyis & Berki, 2014). Creativity is a social phenomenon and the interpersonal interactions among specific groups contribute to it (Sawyer, 2006). Kamylyis and Berki define collaboration as "the common efforts of two or more individuals to achieve an innovative outcome that cannot be achieved by a single individual alone". Creativity at the collaborative level is affected by the individual's dispositions (Chirumbolo et al., 2005), interpersonal behavior of group members, characteristics of a group like group size; processes, and other contextual influences like rewards (Mathisen & Einarsen, 2004; Klijn & Tomic, 2010; Shalley & Gilson, 2004; Zhou & Hoever, 2014). Group creativity is considered superior to individual creativity (Osborn, 1953; Brophy, 2006; Sawyer, 2006). However, some researchers argued against this and claimed the 'process loss' in brainstorming, thereby reducing productivity and also leading to lesser idea generation than the individuals (Mullen et al., 1991; Litchfield, 2008; Goldenberg & Wiley, 2019). Brophy discussed further those complex problems are solved better by groups, but individuals provide original and useful solutions to problems with a single issue (Brophy, 2006). Collaboration enhances creative potential as it develops thinking ability and provides different perspectives (Kamylyis & Berki, 2014). This reflects that some dimensions of creativity are exhibited better by individuals and some by groups.

HYPOTHESIS 1: Groups are higher on fluency and flexibility than individuals.

HYPOTHESIS 2: Individuals are higher on originality than the group.

3.2. Guidance and design thinking

The term "guidance" has been defined by several psychologists. Strang (1947, p. 5) defined guidance as, "the process of helping individuals through their efforts to develop and discover their potentialities for personal happiness and social usefulness.". Guidance is the assistance provided by the qualified or trained individual to the one who needs to learn the ways or processes in which the guide has expertise (Crow & Crow, 1951; Jones, 1942); also, to help the individual unleash the potential (Myers & Gray, 2017).

Based on the definitions above, we use the term “guidance” in this research with reference to academic settings. In the academic setting, especially when the individual enrolls for career-related courses like a degree in business administration or in design thinking, it is with the expectation to learn from the experts who can guide them to develop domain-specific competencies. Design thinking is considered to develop competencies such as collaboration, creativity, problem-solving, and empathy that are fostered in academic settings (Jamal et al., 2021) by teachers who are facilitators and not instructors (Scheer et al., 2012) and hence students are assigned challenging tasks with tools and activities which require collaboration (Pande & Bharathi, 2020). The facilitators provide a conducive environment for students to reflect upon the positive and negative learnings from these activities, stimulating the students to unleash their creative potential (Guaman-Quintanilla et al., 2023).

Guidance here means continuous intervention (Creativity and Design thinking course) to stimulate and help the students to set up worthwhile, achievable purposes and develop abilities, which will make it possible for them to achieve their purpose by reflecting upon their successes and failures.

3.3. Creativity when guided

Different theories like the developmental theory of creativity (Helson, 1999; Subotnik & Arnold, 1998; Albert & Runco, 1989), scaffolding (Daniels, 2001; Bruner, 1999), social constructivism (Vyogtsky, 1978), and sociocultural theory and zone of proximal development (Vyogtsky, 1978) support the intervention in form of “guidance” to enhance cognitive development. For the current study, we are focusing on Vygotsky’s theory (1978).

Vygotsky (1978) advocates that there are two levels of development: actual and potential level. Distinguishing the two levels he paraphrases,

“The level of actual development is the level of development that the learner has already reached and is the level at which the learner is capable of solving problems independently. The level of potential development (the “zone of proximal development”) is the level of development that the learner is capable of reaching under the guidance of teachers or in collaboration with peers. The learner is capable of solving problems and understanding material at this level that is not capable of solving or understanding at one’s level of actual development; the level of potential development is the level at which learning takes place. It comprises cognitive structures that are still in the process of maturing, but which can only mature under the guidance of or in collaboration with others”. He called these ‘others’ as “More Knowledgeable others” (MKO), who have a better understanding or a higher ability level than the learner, concerning a particular task, process, or concept like a teacher, coach, elder relative, etc.

3.4. Role of guidance and collaboration

Researchers have been working and publishing on nurturing and enhancing creativity by instructions and guidance (Sharma & Sharma, 2018; Sharma et al., 2019; Bruner, 1965; Scott et al., 2004; Smith, 1998; Gilson & Litchfield, 2017, Litchfield & Gilson, 2013). Few researchers believe that there is no impact of guidance on creative thinking (Basadur et al., 2000). However, a few others refute this and posit that guidance enhances creative thinking (Kabanoff & Bottger, 1991; Runco & Basadur, 1993; Wang & Horng, 2002).

Creativity by instruction guides the individual to develop divergent thinking skills (Smith, 1998; Bodrova & Leong, 2001; Diamond et al., 2007; Caskin & Goldschmidt, 2000). Research has shown that novice and expert thoughts are different (Bransford et al., 2000; Crawford & Brophy, 2006). A basic understanding of and expertise in domain knowledge is required for creative thinking (Bransford et al., 2000; Crawford & Brophy, 2006). Guided learning develops information-processing ability (Bransford et al., 2000; Sawyer, 2005; Crowe et al., 2008); association of diverse concepts and organization of data (Hatano & Ouro, 2003; Schwartz et al., 2005), and information in a framework (Bransford et al., 2000; Sawyer, 2005; Schwartz et al., 2005). Providing guidance increases flexibility and originality (Koutsoupidou & Hargreaves, 2009).

Scott et al. (2004) posits that guidance for creative thinking helps in divergent thinking, problem-solving, and idea generation by “developing and providing guidance concerning the application of requisite cognitive capacities ... [and] a set of heuristics or strategies for working with already available knowledge”.

Guided learning enhances creativity dimensions of fluency, originality, and flexibility, both at the individual level (Bender & Vredevoogd, 2006; Kabanoff & Bottger, 1991; Runco & Basadur, 1993; Wang & Horng, 2002) and at the group level (Firestien & McCowan, 1988; Firestein, 1990; Fontenot, 1993; Puccio et al., 2006; Runco, 2007).

HYPOTHESIS 3a: The flexibility of guided individuals (Design thinking students) is higher than that of non-guided individuals.

HYPOTHESIS 3b: The flexibility of the guided group (Design thinking students) is higher than that of the non-guided group.

HYPOTHESIS 4a: The fluency of guided individuals (Design thinking students) is higher than that of non-guided individuals.

HYPOTHESIS 4b: The fluency of the guided group (Design thinking students) is higher than that of the non-guided group.

HYPOTHESIS 5a: The originality of the guided individual (Design thinking students) is higher than that of the non-guided individual.

HYPOTHESIS 5b: The originality of the guided group (Design thinking students) is higher than that of the non-guided group.

4. Research methodology

4.1. Research design, data, and method

4.1.1. Respondents

The participants of the study were students from some state and private higher education institutions in India. The average age of the participants was 21.5 years. 200 students agreed to participate in the experiment but around 21 backed out either before the test or during the test. Finally, the total number of respondents was 179 which included approximately the same number of males (N = 87) and females (N = 92). Data were collected from individuals (N = 159) and groups (N = 20) under two categories: non-guided and guided. Each group consisted of 5 individuals totaling 100 participants for group intervention. The prior consent was taken from the participants.

4.1.2. Research design

The sample included 79 respondents and 10 groups who were non-guided and 80 respondents and 10 groups who were guided. The sample for non-guided respondents was drawn from the students of the Masters of Business Administration program and for the respondents, under the “guided” category the students of Masters of Design who were specializing in design thinking were approached.

Non-guided individuals made the control group and the three experimental groups were non-guided team/groups, guided individuals, and guided team/groups.

The experiment was planned in the following manner. Four groups were formed from the total respondents for each study. The four study groups were as given:

Study 1 = Individual (Non-Guided) ----Control Group. The participants responded individually without any guidance.

Study 2 = Individual (Guided) -----Experimental. The participants responded individually but guidance was provided.

Study 3 = Team (Group) (Non-Guided) ----Experimental. No guidance was provided but the unit of participation was manipulated and the participants responded as a group.

Study 4 = Team (Group) (Guided) ----Experimental. Both the unit of participation and the guidance were manipulated.

4.1.3. Instrument, response, data, and scoring

An experiment was conducted based on the Wallach-Kogan test (1965) of creativity to assess the fundamental creativity dimensions: originality, fluency, flexibility, and Torrance test of creative thinking for elaboration. It is a reliable and valid test (Cropley & Maslany, 1969).

The test had four tasks out of which three were verbal stimuli and one was visual stimuli.

1. Task 1 is named “*Instance test*” in which a property is given e.g. round, and the respondent is asked to write the objects with that property like list all round objects.
2. Task 2 is an “*alternate uses*” test which is based on Guilford’s (1967) Alternative Uses test which requires the subject to provide alternate uses of the object e.g. button.
3. Task 3 is named “*Similarities*” is based on contrasting two objects e.g. similarities between milk and meat.
4. Task 4 is called “*Pattern Meanings*” in which the subject is given the incomplete drawing, to guess about the complete drawing. This was adopted from Torrance Tests of Creative Thinking (TTCT) (Torrance, 1964).

The test assesses the participants based on the four dimensions of divergent thinking: *fluency* (number of responses); *flexibility* (the number of the different categories of response); *elaboration* (detailing of the response); *originality* (newness and uniqueness of the responses).

4.1.4. Procedure

Students were informed about the objectives of the experiment and its confidentiality. They were not allowed to use mobile and laptops during the experiment to strictly maintain the originality of their response. The principal investigator administered the test with the help of two research assistants. Each task was announced to them sequentially. They were allowed

4 minutes for each task so a total of around 16 minutes. They had a choice to opt out of the study. In the case of groups, the students were asked to form the groups on their own, and then the test was conducted. This was allowed to provide for the comfort of discussion.

4.1.5. Data collection

The recorded response was collected from students and documented in a file. The response had each participant's consent. The responses were then recorded on the computer and further tabulated in Excel format for further analysis of the data.

The study had manipulations based on the level of analysis i.e. individual or group and based on guidance provided i.e. guided and non-guided making it a 2X2 study matrix. The same four tasks were given to all the study groups. The four studies were as follows:

Study 1 Individual-Non-guided: The sample here was the one from the masters of business administration program who had no or cursory formal training in "design thinking" and so is called "non-guided" for our study. The respondents were asked to complete the task individually.

Study 2 Groups-Non-guided: The sample here was the one from the masters of business administration program who had no or cursory formal training in "design thinking" and so is called "non-guided" for our study. The respondents were asked to form groups of 3–5 people and to complete the assigned tasks in a group.

Study 3 Individual-Guided: The sample here was the one from the masters of design program who had formal training in "design thinking" and so is called "guided" for this study. The respondents were asked to complete the task individually.

Study 4 Groups-Guided: The sample here was the one from the masters of design program who had formal training in "design thinking" and so is called "guided" for this study. The respondents were asked to complete the task in groups.

4.1.6. Scoring key, assessment, and its validation

To validate the process two evaluators separately assessed the number of distinct themes. In case of difference between the two evaluators, the discussion between the evaluators was conducted and the responses were considered only if the evaluators agreed. The cross-validation was also done by the participants. The assessment was discussed with ten subjects to understand the veracity of the assessment method. For assessment, the data was checked for irrelevant and wrong responses, which were canceled, and then *fluency* was measured by counting the number of relevant responses; *flexibility* was assessed based on the number of themes identified by the respondent; *originality* was measured on the scale of 0–2 where "0" refers to "not original at all" to "2" refers to "very original". For every response mentioned by less than 5%, 2 points were awarded; for those mentioned by 5–10%, 1 point was given and responses common for more than 10% were given "0" (Hong & Milgram, 1991; Milgram et al., 1987; Wallach & Kogan, 1965). *Elaboration* was also based on the description of the response and was assessed on a scale of 0–2. If the respondent gave only use then "0", an explanation of one step was given "1", and if more explanation was given, it was "2". For example, a respondent who replied "A tribal man wearing a turban", is given "2" points.

4.2. Measurement and analysis

4.2.1. Validity and reliability assessment

Before turning to our primary research questions, preliminary analyses for internal consistency were conducted. As this study had multiple-response measures, we computed Cronbach's alpha. Cronbach's alpha of the test was .885 which proves the reliability of the test. The test had convergent validity as the Average Variance extracted (AVE) was more than 0.5 and less than composite reliability (CR). This establishes the internal consistency in the reliability and validity of the data (Table 1, Figure 2).

Table 1. Model fit, reliability, and Validity measures of a one-factor model (source: created by authors)

Measures	Values	Interpretation
Cronbach alpha	0.885	Good & acceptable
Composite reliability	0.895	Good & acceptable
Average variance Extracted	0.685	Good & acceptable
Chi-square(CMIN/(df)	2.5 (5.02/2)	Good & acceptable
CFI	.949	Good & acceptable
RMSEA	.026	Good & acceptable
SRMR	.049	Good & acceptable

4.2.2. Data analysis

Linear Structural Equation Models (SEM) were used to ascertain the hypothesized model. The results were analyzed through SPSS 20.0 and AMOS 21 through the maximum likelihood method. The confirmatory factor analysis (CFA) was done, to find the best model fit for the factor model of creativity.

Model Goodness fit was assessed based on Chi-square (χ^2), GFI (Goodness-of-Fit Index), CFI (Comparative Fit Index), and RMSEA (Root Mean Squared Error of Approximation) (Brown, 2006; Jackson et al., 2009; Macmann & Barnett, 1994; Schreiber et al., 2006). MANOVA was done to analyze the differences between the creativity dimensions in all four studies.

The role of "Guidance" as moderator was to facilitate, review, and help apply creativity. Hayes PROCESS Model (Hayes, 2012) was used to find the moderation effect of "guidance" on creativity dimensions (Table 1).

5. Results

5.1. Descriptive statistics: mean and standard deviation

The data was collected from 159 individuals and 20 groups. The respondents were both from the "guided" and "non-guided" category. Under the "guided" category, 80 individuals and 10 groups were taken; for non-guided, 79 individuals and 10 groups responded. The mean value of fluency ($M_{\text{fluency-individual}} = 5.17 < M_{\text{fluency-group}} = 6.19$) and flexibility ($M_{\text{flexibility-individual}} = 3.10 < M_{\text{flexibility-group}} = 4.01$) is higher for the groups than the individuals, whereas the mean value of originality ($M_{\text{originality-individual}} = 2.11 > M_{\text{originality-group}} = 2.04$) and elaboration ($M_{\text{elaboration-individual}} = 2.12 > M_{\text{elaboration-group}} = 2.06$) is higher for the individuals than the groups (Table 2).

Table 2. Descriptives based on level of respondents (Individual or Group) (source: created by authors)

		N (responses)	Mean	Std. Deviation
Fluency	0	159	5.17	2.28
	1	20	6.19	1.97
	Total	179	5.28	2.27
Flexibility	0	159	3.10	1.57
	1	20	4.01	1.55
	Total	179	3.19	1.59
Originality	0	159	2.11	1.711
	1	20	2.04	1.40
	Total	179	2.10	1.67
Elaboration	0	159	2.12	1.36
	1	20	2.06	.83
	Total	179	2.11	1.31
"Individual" is coded as "0" and "group" as "1"				

On the basis of guidance, the mean value of fluency ($M_{\text{non-guided}} = 5.89 > M_{\text{guided}} = 4.67$), originality ($M_{\text{non-guided}} = 3.09 > M_{\text{guided}} = 1.13$), and elaboration ($M_{\text{non-guided}} = 2.21 > M_{\text{guided}} = 2.02$) is higher for the non-guided individual than the guided individual whereas the mean value of flexibility ($M_{\text{non-guided}} = 2.87 < M_{\text{guided}} = 3.51$) is higher for the guided individuals than the non-guided individuals (Table 3).

Table 3. Descriptive statistics based on "guidance" (source: created by authors)

		N	Mean	Std. Deviation
Fluency	0	79	5.89	2.52
	1	80	4.67	1.81
	Total	159	5.28	2.27
Flexibility	0	79	2.87	1.75
	1	80	3.51	1.35
	Total	159	3.19	1.59
Originality	0	79	3.09	1.69
	1	80	1.138	.932
	Total	159	2.10	1.67
Elaboration	0	79	2.21	1.05
	1	80	2.02	1.53
	Total	159	2.11	1.31
"Non-guided individual" is coded as "0" and "guided individual" as "1"				

Multivariate analysis of variance (MANOVA)

For conducting MANOVA the studies were coded as follows: Study 1 (Individual – Non guided) is 1; Study 2 (group – Non guided) is 2; Study 3 (Individual – guided) 3 and Study 4 (Group – Guided) is 4.

Table 4. Descriptive statistics based on different participant units (source: created by authors)

	Participant units	Mean	Std. Deviation
Fluency	1	5.8090	2.55382
	2	6.8214	2.08024
	3	4.4746	1.69295
	4	6.0000	2.20164
	Total	5.2832	2.27736
Flexi	1	2.8438	1.80397
	2	3.1786	1.21376
	3	3.3659	1.28021
	4	4.5250	1.55210
	Total	3.1930	1.59939
Origin	1	3.046	1.732
	2	3.562	1.27
	3	1.106	.929
	4	1.20	.8959
	Total	2.10	1.68
Elab	1	2.163194	1.0752679
	2	2.714286	.7627878
	3	2.090580	1.6331645
	4	1.600000	.5163978
	Total	2.120253	1.3228107

Note: Here NGI (1) stands for Non guided Individual; NGG (2) is a Non-guided group; GI (3) is a Guided Individual; GG (4) is a guided group.

Table 4 shows that Non-Guided Individual (NGI) ($M_{ngi} = 5.8$) was lower on fluency than Non-guided group (NGG) ($M_{ngg} = 6.8$); NGI ($M_{ngi} = 5.8$) is higher than GI ($M_{gi} = 4.47$); NGG ($M_{ngg} = 6.8$) was higher than (Guided Group) GG ($M_{gg} = 6.0$); (Guided Individual) GI ($M_{gi} = 4.47$) was less than GG ($M_{gg} = 6.00$). The data implies that fluency was higher in groups than in individuals and non-guided units are better than guided units in fluency.

For flexibility NGI ($M_{ngi} = 2.8$) was lower than NGG ($M_{ngg} = 3.1$); NGI ($M_{ngi} = 2.8$) was lower than GI ($M_{gi} = 3.3$); NGG ($M_{ngg} = 3.1$) was lower than GG ($M_{gg} = 4.5$); GI ($M_{gi} = 3.3$) was less than GG ($M_{gg} = 4.5$). The data implies that flexibility was higher in groups than individuals and guided units are better than non-guided units in fluency.

NGI ($M_{ngi} = 3.0$) was low on originality than NGG ($M_{ngg} = 3.5$); NGI ($M_{ngi} = 3.0$) was higher than GI ($M_{gi} = 1.1$); NGG ($M_{ngg} = 3.5$) was higher than GG ($M_{gg} = 1.2$); GI ($M_{gi} = 1.1$) was less than GG ($M_{gg} = 1.2$). The data implies that originality was higher in groups than individuals and non-guided units are better than guided units in originality.

Table 4 shows that NGI ($M_{ngi} = 2.16$) was low on elaboration than NGG ($M_{ngg} = 2.7$); NGI ($M_{ngi} = 2.16$) was lower than GI ($M_{gi} = 2.09$); NGG ($M_{ngg} = 2.7$) was lower than GG ($M_{gg} = 1.6$); GI ($M_{gi} = 2.09$) was higher than GG ($M_{gg} = 1.6$). The data does not reflect clearly upon the "elaboration".

MANOVA shows that there was a significant difference across four studies with $F(12,399) = 33.2$ at $p < 0.05$. The partial Eta value was .457. The output of the Post hoc test Tukey HSD shows that there was a significant difference between Non-guided Individuals and Guided

Individuals on the “fluency” parameter. *The non-guided individuals have higher fluency than the guided individual* ($M_{ngi} - M_{gi} = 1.33$; $\alpha < 0.05$). Even the Non-guided group and Guided Individual show a significant difference in “fluency” with non-guided groups having higher fluency than guided individuals ($\mu_{gi} - \mu_{ng} = -2.34$; $\alpha < 0.05$) (Table 5).

Table 5. MANOVA output (source: created by authors)

Tukey HSD					
Dependent Variable	(I) discriminant	(J) discriminant	Mean Difference (I-J)	Std. Error	Sig.
Fluency	1	2	−1.0124	.860	.643
		3	1.3344*	.366	.002
		4	−.1910	.733	.994
	2	1	1.0124	.860	.643
		3	2.3468*	.862	.036
		4	.8214	1.07	.869
	3	1	−1.3344*	.366	.002
		2	−2.3468*	.862	.036
		4	−1.5254	.735	.166
	4	1	.1910	.733	.994
		2	−.8214	1.07	.869
		3	1.5254	.735	.166
Flexibility	1	2	−.3348	.616	.948
		3	−.5222	.262	.196
		4	−1.6813*	.525	.009
	2	1	.3348	.616	.948
		3	−.1874	.617	.990
		4	−1.3464	.766	.299
	3	1	.5222	.262	.196
		2	.1874	.617	.990
		4	−1.1591	.526	.128
	4	1	1.6813*	.525	.009
		2	1.3464	.766	.299
		3	1.1591	.526	.128
Originality	1	2	−.5164	.5421	.776
		3	1.93*	.230	.000
		4	1.84*	.462	.001
	2	1	.5164	.542	.776
		3	2.45*	.543	.000
		4	2.36*	.674	.003
	3	1	−1.93*	.2306	.000
		2	−2.45*	.5431	.000
		4	−.0937	.4633	.997
	4	1	−1.84*	.462	.001
		2	−2.36*	.674	.003
		3	.0937	.4633	.997

End of Table 5

Tukey HSD					
Dependent Variable	(I) discriminant	(J) discriminant	Mean Difference (I-J)	Std. Error	Sig.
Elaboration	1	2	-.55	.523	.719
		3	.072	.222	.988
		4	.563	.446	.589
	2	1	.551	.523	.719
		3	.623	.524	.635
		4	1.114	.651	.322
	3	1	-.072	.222	.988
		2	-.623	.5246	.635
		4	.490	.4474	.692
	4	1	-.563	.446	.589
		2	-1.114	.6517	.322
		3	-.490	.4474	.692

Note: Here NGI (1) stands for Non guided Individual; NGG (2) is a Non-guided group; GI (3) is a Guided Individual; GG (4) is a guided group. Based on observed means. The error term is Mean Square (Error) = 1.749.

*. The mean difference is significant at the .05 level.

Only Non-guided individuals and Guided groups show significant differences in flexibility with guided groups having higher flexibility than Non-guided individuals ($M_{gg}-M_{ngi} = 1.68$; $\alpha < 0.05$).

On "originality" non-guided individual as well as non-guided groups differs significantly from both guided individual and guided group. The non-guided category has higher originality than the guided category ($M_{gg}-M_{ngi} = -1.84$; $\alpha < 0.05$; $M_{gi}-M_{ngi} = -1.93$; $\alpha < 0.05$; $M_{gg}-M_{ngg} = -2.36$; $\alpha < 0.05$; $M_{gi}-M_{ngg} = -2.45$; $\alpha < 0.05$).

There was no significant difference between any categories on the bases of "elaboration".

The results explain the category that best exhibits the particular creativity parameter. If the task requires a greater number of ideas i.e. fluency, in that case, the non-guided category and especially the non-guided groups would give favorable results ($M_{ngg} = 6.8$). The task that requires high flexibility should be assigned to guided groups ($M_{gg} 4.5$). The originality of the ideas would be best if the task was assigned to a non-guided category, especially the non-guided group ($M_{ngg} = 3.56$). Non-guided groups are best at "elaboration" ($M_{ngg} = 2.7$).

Since MANOVA output shows the difference in the creativity parameters between guided and non-guided categories, so to understand the effect of "Guidance", PROCESS was used which checked for the moderation effect.

5.2. Moderation

The participant unit (Individual or Group) was hypothesized to affect the parameters of creativity when considered separately i.e. flexibility, fluency, elaboration, and originality (Figure 1). It was further hypothesized that the guidance (design thinking degree) moderates the relationship between the participant unit and the creativity parameter. The PROCESS SPSS Macro version 2.13, model 1 was used to calculate the regression coefficients for each creativity

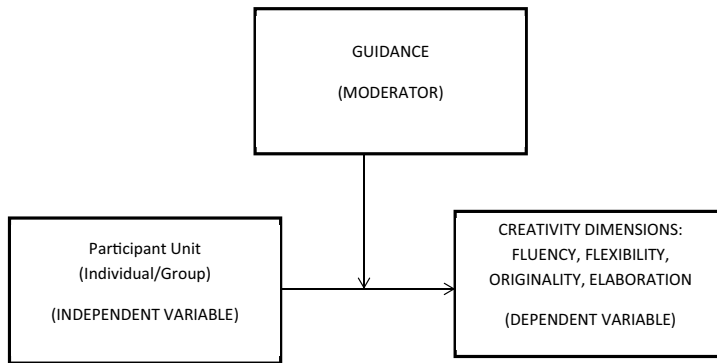


Figure 1. Hypothesized model with guidance as moderator (source: created by authors)

dimension independently. The procedure of Hayes for moderation analysis was used for binary covariates (participant unit and guidance). *The results show that Guidance moderates the relationship between the participant unit (individual/group) and two dimensions (fluency and flexibility) of creativity but not with originality and elaboration.* For fluency $\beta = 1.64$, $t = (2.33, p = .02)$ and $CI = [.2520, 3.0312]$ which shows the moderation effect of guidance. For flexibility $\beta = 1.21$, $t = (2.42, p = .01)$ and $CI = [.2238, 2.20]$ which shows the moderation effect of guidance. For Originality $\beta = .261$, $t = (.585, p = .55)$ and $CI = [-.6196, 1.14]$ which shows no moderation effect of guidance. For Elaboration $\beta = -.292$, $t = (-.68, p = .4)$ and $CI = [-1.14, .556]$ which shows no moderation effect of guidance (Table 6).

Table 6. Moderation effect of guidance on the four creativity dimensions (source: created by authors)

Creativity Dimension (Dependent Variable)	Effect (β)	Se	t	P	LLCI	ULCI
Fluency	1.6416	.7035	2.3337	.0209	.2520	3.0312
Flexibility	1.2167	.5027	2.4206	.0167	.2238	2.2097
Originality	.2610	.4458	.5854	.5591	-.6196	1.141
Elaboration	-.2925	.4298	-.6805	.4972	-1.1416	.5566

5.3. Model fit statistics

The Principle component analysis of the data identifies four factors with high factor loading which was the same as the four variables considered for study i.e. fluency, flexibility, originality, and elaboration. There was a high correlation between the four variables (Table 7a) which was confirmed through confirmatory factor analysis (CFA) which shows that the one-factor model was the best fit for the study with standard test Chi-square, $\chi^2_{df} = 2.5$; however it has been observed that one should not rely exclusively on Chi-square for a model fit measure, so we went for alternate test for model fit measures- the comparative fit index, good fit index, RMR, root mean square error for approximation. The alternate model fit measures obtained indicated a good model fit. GFI = .935, CFI = .949 and SRMR = 0.049; RMSEA = 0.02. All four variables have regression coefficients higher than 0.6 which further reinstates the one-factor model (Table 7b).

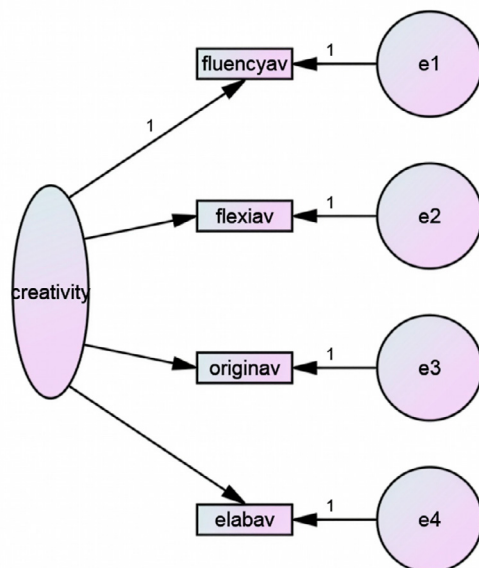


Figure 2. One factor model (source: created by authors)

Table 7a. Correlation Matrix (source: created by authors)

Variables				
	fluency	Flexibility	originality	elaboration
Fluency	1	.823**	.781**	.687**
flexibility	.823**	1	.546**	.675**
originality	.781**	.546**	1	.540**
elaboration	.687**	.675**	.540**	1

Note: **Correlation is significant at the 0.01 level (2-tailed).

Table 7b. Standard regression weight (source: created by authors)

		Estimate
Fluency	<--- creativity	.950
flexibility	<--- creativity	.815
originality	<--- creativity	.777
elaboration	<--- creativity	.673

5.4. Hypothesis testing

Based on the analysis and the measures of model fit, the hypothesis was checked and evaluated. The results of hypothesis testing are summed up in Table 8. Hypotheses 1 and 3 (a, b) are accepted. The other hypotheses are rejected.

Table 8. Hypothesis testing (source: created by authors)

No.	Hypothesis statement	Experimental outcome	Remarks
1	<i>HYPOTHESIS 1: Groups are higher on fluency and flexibility than individuals</i>	The results show the significant difference in the creativity of Individuals and Groups. The mean value shows that groups are higher on "fluency" and "flexibility".	Accepted
2	<i>HYPOTHESIS 2: Individuals are higher on originality than the group</i>	The results do not show a significant difference ($p = .510$).	Rejected
3	<i>HYPOTHESIS 3a: Flexibility of the guided individual is higher than that of a non-guided individual</i>	There is a significant difference between Guided and non-guided individuals on the mean score of flexibility ($p < .01$).	Accepted
4	<i>HYPOTHESIS 3b: Flexibility of the guided group is higher than that of a non-guided group</i>	There is a significant difference between Guided and non-guided groups on the mean score of flexibility ($p < .01$).	Accepted
5	<i>HYPOTHESIS 4a: Fluency of the guided individual is higher than that of the non-guided individual</i>	The results show a significant difference ($p < .001$) but the mean values show that the non-guided individuals ($\mu = 5.8$) are better than the guided individuals ($\mu = 4.47$) on fluency.	Rejected
6	<i>HYPOTHESIS 4b: Fluency of the guided group is higher than that of the non-guided group</i>	The results show a significant difference ($p < .001$) but the mean values show that the non-guided groups ($\mu = 6.8$) are better than the guided groups ($\mu = 6.00$) on fluency.	Rejected
7	<i>HYPOTHESIS 5a: Originality of the guided individual is higher than that of the non-guided individual</i>	The results show a significant difference ($p < .001$) but the mean values show that the non-guided individuals ($\mu = 3.0$) are better than the guided individuals ($\mu = 1.1$) on originality.	Rejected
8	<i>HYPOTHESIS 5b: Originality of the guided group is higher than that of the non-guided group</i>	The results show a significant difference ($p < .001$) but the mean values show that the Non guided groups ($\mu = 3.5$) are better than the guided groups ($\mu = 1.2$) on originality.	Rejected

6. Discussion and conclusions

The current experimental study was conducted to identify the role of guidance (design thinking degree) and collaboration in affecting the creativity of the person. The research analysis shows that the four studies are significantly different from each other which imply that the creativity of individuals and group would differ. Also, guidance in the form of a design thinking degree affects creativity.

Out of the four dimensions of creativity, except elaboration, the other dimensions are significantly different across the four studies. The "fluency" dimension of creativity was higher in "non-guided" individuals than "guided" individuals which refute the existing literature which discusses the role of guidance in enhancing fluency and originality (Bender & Vredevoogd, 2006; Kabanoff & Bottger, 1991; Wang & Horng, 2002).

However, the Hayes model of Moderation (Hayes, 2012, Model 1), shows the moderating effect of "guidance" on "fluency" which could be because of higher "fluency" reported by the non-guided participant units than the guided ones. The better results of non-guided participants than the guided participants on "fluency" could be because "idea generation" is the initial phase of the creative process and does not have extensive elaboration, evaluation,

and implementation (Diehl & Stroebe, 1987; Osborn, 1953). The researchers have discussed that the idea-generation process is a cognitive process based on the existing work, which browses the relevant knowledge from long-term memory and applies it to the knowledge in the working memory to generate ideas (Hargadon, 2002; Burroughs et al., 2008; Mednick, 1962; Moreau & Dahl, 2005; Nijstad & Stroebe, 2006). Smith et al. (1993) posit that although prior knowledge facilitates idea generation it also suppresses creativity.

Hence, when the participant unit is provided guidance and has expertise in a particular field, the idea generation would be restricted to their existing knowledge, thereby restricting the scope of thought as mentioned: “We must strike a balance between depth and breadth of knowledge to maximize our creative potential” (Johansson, 2004). This would affect both their “fluency” and “originality”.

The number of ideas generated (Fluency) was important but if the ideas are from the same domain or theme, it would not be able to give a diverse pool for idea development. The group who that was trained in design thinking was high on *flexibility* i.e. *they came out with ideas under diverse themes*. The training in design thinking could stimulate the cognitive aspects of the group members and when the brainstorming happens the diverse views could help increase “flexibility” (Jarwan, 2008; Honig, 2001). “Guidance” moderates “flexibility” which supports the literature (Koutsoupidou & Hargreaves, 2009). The other dimensions of “originality” and “elaboration” are not moderated by “guidance”.

Through this study, we propose the unit of participants to be employed based on the goal of the phase of the creativity and aim of innovation. *If the task requires more ideas i.e. fluency, in that case, the non-guided category and especially the non-guided groups would give favorable results* ($M_{ngg} = 6.8$). *The task which requires high flexibility should be assigned to guided groups* ($M_{gg} = 4.5$).

The originality of ideas would be best if the task was assigned to the non-guided category, especially the non-guided group ($M_{ngg} = 3.56$). *Non-guided groups are best at “elaboration”* ($M_{ngg} = 2.7$). The role of “collaboration” and “guidance” in innovation, creativity, and idea generation was reverberated in this research and supports the extant literature (Kohn & Smith, 2011; Grant, 2016; Markman, 2017; Diehl & Stroebe, 1987). But it also provides direction about employing the specific method according to the requirement of the process of applied creativity (Innovation). The present study has provided experimental evidence about the difference in creativity dimensions in individuals and teams (group) or guided group. It has also provided measurable evidence to prove the moderation role of “Guidance” provided by the Masters of design thinking program in the process of applying creativity in innovation. This also points out the need for Master of business administration programs to include design thinking in the curricula, as it stimulates creativity potential which is critical for the sustainability of business. This study can very well add to the literature on the current sciences of creativity and innovation.

7. Implications

Creativity is not an abstract but a process. Every aspect of this process has different requirements and if that is taken care of, it would facilitate innovation and creativity in organizations.

Work collaborations should be leveraged for fluency and flexibility in creative idea generation (Table 9). Furthermore, the results corroborate the possibility of using the results of this study for the innovation team and the accomplishment of the task assigned.

The current research could help organizations in the innovation process and develop ways of idea generation for product or service development. The study is the first of its kind which discusses the experimental outcome of the three methods – Individual, Guided (Paired), and Collaborated (Team) creativity methods to facilitate idea generation in the organization. The study could help to customize the use of a combination of the methods as a strategy for the creativity and innovation objective of the institution and companies.

Table 9. Implications/Observations from results on the highest value of four creativity dimensions (source: created by authors)

Creativity Dimension (Dependent Variable)	Highest(over-all) observed value	Category	Suggested use in innovation stages
Fluency	6.19	Non-Guided group	When the innovative design is required to add value to the function of a product through the form.
Flexibility	3.51	Guided Group	When variety and response across different categories is needed
Originality	3.09	Guided Individual	In the Ideation and preparation stage
Elaboration	2.21	Guided Individual	In the Incubation stage in Innovation

8. Limitations

The current study was conducted on a sample that included students pursuing a master of business administration and others pursuing a degree in design thinking with the respondent age group of 18–30 years. There could be a difference in outcome if the sample changes. Demography and geography may have different insights on results.

9. Scope for future research

The same study could be conducted longitudinally, to understand the effect of “guidance” on the different dimensions of creativity. The moderating effect of “guidance” could be stronger and more positive in such a study.

Despite the stated limitation, the result points to important outcomes for future studies and interventions. The experiment’s results display excellent fit, good reliabilities, and discriminant and convergent validities. This study proves fundamental for the future understanding between the role of an individual, team (group), collaboration, and Guidance in the creativity application for an innovation task.

Dataset statement

The datasets generated during and/or analyzed during the current study are not publicly available due to confidentiality of data but are available from the corresponding author on reasonable request.

Consent statement

Informed consent was obtained from all individual participants included in the study.

Ethics committee approval

Approval was obtained from the ethics committee of Ahmedabad University. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

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