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Developing and Assessing a Tool to Measure the Creativity of University Students

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KEYWORDS Measurement Instrument. Torrance Test of Creative Thinking (TTCT). Conceptual Map of Creativity in Teaching and Learning. Educational Model of Creative Development (PECEI). Amusement Park Theoretical (APT) Model. Factors. Factor Analysis

ABSTRACT Creativity plays the key role in invention, innovation and problem solving that improve human life. The objective of this article was to develop and assess a tool to measure the creativity of university students. In doing so, a literature study of creativity was embarked upon to identify the underlying variables used to measure creativity. The identified variables were then subjected to a factor analysis process and the reliability of the data tested. Empirical data was collected from 500 full-time students randomly selected (with a response of 322). The results showed that at least twelve factors need to be considered in measuring creativity, namely: Challenging the status quo, Detachment, Synthesis, Cognition, Associate and Communicate, Awareness, Similarity, External motivation, Sensitivity, Experiment and Combine, Dimensional Thinking and Problem-solving. These factors show inherent communal properties (correlating positively with existing theory), and could be grouped into three main categories, namely: cognitive psychology, external influences and personality characteristics. Regarding reliability, acceptable Cronbach Alpha coefficients were calculated, exceeding the minimum coefficient of 0.70. The article highlights the value of creative graduates and the factors that could be utilised to measure their creativity in a South African tertiary education context.

INTRODUCTION

Creative thinking and creative abilities are increasingly being used in finding solutions to problems that impact on human progress and survival. According to Allen (2012:47), creativity plays the key role in invention, innovation and problem solving and can improve the quality of human life. Creativity is "a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results", according to Torrance's (1996:6) definition of creativity (cited in Kim 2006:1). This definition indicates that creativity requires a whole brain approach which includes divergent thinking (the generation of many unique ideas) and convergent thinking (the combination of those ideas into the best result) (Bronson and Merryman 2010:21, 23). In this context, Guilford (1986) cited in Kim (2006:4), noted that creative thinking is different from divergent thinking, because "creativity requires sensitivity to problems as well as redefinition abilities, which include transformations of thought, reinterpretations, and freedom from functional fixedness in driving unique solutions."

Traditionally, educational institutions (from kindergarten to post graduate) focused educational programmes on primarily the development of the intellect and left brain activities which include language, writing, reading, listening, calculating skills, logic, analysis and sequence. The development of right brain activities were left to the music and art departments.

Creativity in particular has become an essential consideration, because "creativity becomes a force of value when it is applied to causes that benefit humankind and the world at large" (Livingston 2010:61). The challenge lies in understanding, harvesting and building up the creativity that students possess and not in teach-

ing creativity per se. Another challenge is to encourage the development of creative motivation, skills and abilities to ensure that adult creative achievement occur (Torrance 1998 in Kim 2006:3) after graduation.

The starting point to overcome the above can be to assess current creativity levels of students using an acceptable creativity measurement tool and to utilise the information obtained to promote the development of students' creative thinking skills. Although such a preliminary creativity measurement tool was developed by Fields and Bisschoff (2013), it still needs to be tested and validated empirically which was done in this article.

Objectives

In order to develop and assess a tool to measure the creativity of university students, the following objectives were set:

- Perform a literature study on creativity in higher education;
- Identify the underlying variables that can be used to measure creativity; and to
- Determine the validity and reliability of the data.

Observations

The purpose of universities and other tertiary educational institutions lies beyond career preparation only. These institutions should ensure that students can meet the challenges of the future and contribute original thought to challenges in the workplace and society as a whole. It is therefore necessary to support and guide students to apply creative thinking skills and to develop creativity on various levels. According to Jackson (2006:1), enabling students to be creative should be "an explicit part of the tertiary education experience". Tertiary education should encourage students to better understand and use their own creativity and to apply their creativity to develop innovations that can enhance the quality and sustainability of human life.

The problem with tertiary education, and specifically in South Africa, is that it normally pays little attention to students' creative development because the focus is more on theoretical knowledge and intellectual development. Creativity is seldom seen as a critical learning outcome of tertiary education (except for certain disciplines in the performing and graphic arts) and is often constrained by structured course designs and learning and assessment processes focusing on theoretical knowledge and understanding (convergent thinking) only (Jackson 2006:2,4). Measuring creativity at tertiary educational level is an additional challenge. The problem at South African tertiary educational institutions appear to be that different disciplinary interpretations of creativity exists, which makes the identification and measurement of creativity difficult. Focus on creativity is also placed more on subjects like Arts than Sciences and to agree to measure creativity of all students and then to find a valid and reliable tool to use nationally is a challenge. It is however critical to focus on creativity at this level of education as it has an impact on how South African graduates are able to apply their education to resolve business challenges creatively now and in the future.

Pérez Alonso-Geta (2009: 310-311) explains that the creation of measuring instruments to identify the creative abilities of students are problematic. Numerous tests have been produced based on different definitions of creativity. Based on these tests, two main tendencies in measuring creativity can be identified (Pérez Alonso-Geta 2009:311), namely:

- Tests that measure creativity through the ability to produce creative "answers" when confronted with a specific stimuli, and
- Tests that measure characteristics which form the basis of the creative personality.

A key test to take note of in the above context is the Torrance Test of Creative Thinking (TTCT) which is recommended in the educational field and in the corporate world (Kim 2006:1). The test can be administered as an individual or group test from kindergarten level to graduate level and beyond. It is also the most referenced of all creativity tests (Kim 2006:1). Torrance (1990) as cited in Kim (2006:5) identified creative strengths in his TTCT assessments, namely "emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or circles, unusual visualization, internal visualization, extending or breaking boundaries, humour, richness of imagery, colourfulness of imagery and fantasy". However, Tor-

rance neither concluded that his tests assess all dimensions of creativity, nor did he suggest that it should be used alone as a basis for decisions (Treffinger 1985 cited in Kim 2006:3). The main focus of Torrance's TTCT was to understand and nurture qualities that help people express their creativity (Kim 2006 cited in Karpova et al. 2011: 56). The tests serve as tools for creativity enhancement specifically and not to measure creativity (Kim 2006).

Guilford's (1959) Structure of the Intellect Model identified fluency, flexibility, originality and elaboration as divergent-thinking factors (Kim 2006:4). These factors were used by Torrance in his TTCT-Figural test (Torrance 1974 cited in Kim 2006:4). After more research, Torrance (1990) cited in Kim (2006) added abstractness of titles (it measures the degree a title moves beyond concrete labelling of the pictures drawn) and resistance to premature closure (the degree of psychological openness).

Kleiman (2008:210) developed a conceptual map of creativity in teaching and learning which was created from Phenomenography. Phenomenography focuses on the different number of ways in which individuals "experience, perceive, apprehend, understand and conceptualise various phenomena" (Tan and Prosser 2004:269 as cited in Kleiman 2008:210). A list of thirty possible different variations of the experience of creativity in learning and teaching emerged (Kleiman 2008:211). These variations were categorised under five main categories which focused varyingly on the experience of creativity as:

- *A constraint-focused experience* which appears in several forms, for example constrained in order to enable student creativity, constrained by institutional environment, and constrained in order to meet the expectations of the students.
- *A process-focused experience* which includes for example processes that lead to explicit and implicit outcomes and those that are not necessarily linked to any outcome.
- *A product-focused experience* focuses on the production of something new and original, or something in which ideas are combined to create something of utility and value (innovation).
- *A transformation-focused experience* is the engagement in a process that is transformative and chance and risk-taking are key factors in this category.
- *A fulfilment-focused experience* is linked to ideas of personal and professional fulfilment and freedom.

The research is still emergent and requires further analysis, but it offers helpful clues regarding creativity in the context of learning and teaching.

The Educational Model for Creative development (PECEI) was developed by the Institute of Creativity and Educational Innovations (INCEI) at the University of Valencia. The model adopts the approach that creativity can be taught and is an acquired skill. The model is related to the individual (development of creative and entrepreneurship spirit), to the process (of innovation), to the product, and to the context. Kleiman's (2008:211) conceptual map identifies the process and the product. Mental and behavioural aspects are measured in order to evaluate creativity and behavioural and biographical inventories are then used on those identified as more creative than others (Pèrez Alonso-Geta 2009:311).

The model assumes that creativity involves a set of attributes (like self-confidence, desire for achievement, sensitivity) and thinking skills (like fluency, mental flexibility, imagination). The model can be used to teach creativity and measure the educational quality of creativity (Pèrez Alonso-Geta 2009:308).

In addition to the above, the model implies that the teaching practice will always be "probabilistic" in the sense that certain teaching practices might not produce certain outcomes due to for example the "resistance" of students and an educator that abandon or cling to authority.

The creative process, as per the PECEI model (Pèrez Alonso-Geta 2009:309-310), requires:

- Inventiveness by having an idea, a hypothesis, a project and being able to develop it.
- The ability to use ideas outside of the judgment system.
- Ideas have to manifest, be developed, tested, evaluated and modified and the ability to escape the typical dominant idea should be enhanced.
- Stimulation, intuition, direction and perseverance are required to overcome the environment and its resistance and to give incentive to the effort of achieving.
- Divergent and critical thinking are essential because it defines the direction when confronted with multiple options.

- Various strategies can be used to improve the creative process

To explore creativity further, common indicators of creative performance need to be identified. Baer and Kaufman (2005:4-6) highlighted the initial requirements for creativity in their Amusement Park Theoretical (APT) Model as:

- Intelligence – a basic level of cognitive ability is needed to be creative. It appears that once a person's IQ reaches approximately 120, the chances are small that there will be any increase in creativity even if the IQ increases (Baer and Kaufman 2005). In extreme cases, Simonton (1994 as cited in Baer and Kaufman 2005:5) suggested that a high-IQ individual may struggle to communicate creative ideas effectively which could result in brilliant ideas being lost. It has to be noted that there is a positive correlation between IQ scores and creative performance in all domains in the APT Model.
- Motivation – refers to the necessity of being highly motivated to create something due to the fact that motivation changes from task to task. Motivation results from positive and negative experiences and produce interests and drives in individuals. Motivation that increases productivity is likely to lead to higher levels of creativity.
- Suitable environments – refers to past and present environmental influences. Individuals tend to be more creative when their creative thoughts are supported by family, their community and their culture. Environments also often contain the tools and material necessary for individuals to be creative.

In the above context, there is a lack of one specific valid and reliable test that can be used to measure creativity at tertiary educational level, and specifically in the South African context. As a result, a theoretical model was developed by Fields and Bisschoff (2013) after exploring an array of key creativity models and tests. This theoretical framework is now tested empirically and also measured for reliability.

RESEARCH METHODOLOGY

Quantitative research has been performed by means of a self-administered questionnaire and was exploratory in nature. The objective was to develop and assess a tool to measure creativity. The questionnaire consisted of selected criteria identified from literature (See Fields and Bisschoff (2013) for details on the development of the questionnaire). A 7-point Likert scale was used to capture the perceptions of respondents. The data was subjected to a principle factor analysis using a Varimax, normalised rotation. The reliability coefficient, Cronbach Alpha, was used to test the reliability and internal stability of the data and the underlying factors. A convenience sample of 500 full-time university students at the North-West University (Potchefstroom Campus) was drawn. A total of 322 questionnaires were completed (signifying a response rate of 64.4%).

RESULTS AND OBSERVATIONS

Demographic Profile

In terms of the age demographic, most of the respondents fell within the age group of 18-21 years (77.6%). A total of 21.1% of the respondents fell within the age group of 22-25 years, 0.6% within the age group of 26-29 years, 0.6% within the age group of 30-35 and no respondent was older than 35 years. The majority of the respondents were female (58.7%).

The majority of the students in the sample were first year students (37.9%) followed by 25.2% of the respondents who were third year students**.** The remaining 36.9% of the respondents were equally distributed between second year and fourth year students.

The majority of students who participated in the study were studying at the Faculty of Economic and Management Sciences (68.9%), while the rest of the students originated from other faculties.

Factor Identification

The data were subjected to exploratory factors using a Varimax rotation. This rotation was selected because of its ability to maximise variance explained (Field 2007:636). Factor loadings of 0.40 were set as the minimum factor loading, while the data is also required to explain a cumulative variance of in excess of 60% (Field 2007:668). The data were subjected to the Kaizer, Meyer and Olkin (KMO) test of sampling adequacy and the Bartlett's test of sphericity to ensure that factor analysis is a suitable analyti-

cal tool to employ. The data required three rounds of purification to eliminate all non-loading criteria (factor loadings below 0.40) as well as the criteria that duel-load strongly on more than one factor. The eliminated criteria appear in Table 1.

Table 1: Non-relevant items

CN5	I am always motivated to be creative in my own interest areas
GN1	I can find the connection between items
B1	I have the ability to produce a great number of ideas
A7N3	I look for similarity in solutions
A2N4	I consider the dimensionality of an issue to create ideas in terms of colour
C1	I am driven by external pressures (including other people) to solve problems
GN3	I like to combining various concepts to find solutions to problems
CN3	I am self-motivated to resolve externally defined problems
A4N1	To find creative solutions, I combine objects
A4N3	To find creative solutions, I combine processes
A4N2	To find creative solutions, I combine concepts
FN1	I propose new ideas on a regular basis
DN1	I attain understanding from a variety of information sources without difficulty
DN8	I can predict appropriate creative solutions to a problem after analysing the contradictions in a problem
HN1	I am a sensitive person
A5N1	To find creative solutions, I separate concepts
A5N2	To find creative solutions, I separate processes
A2N2	I consider the dimensionality of an issue to create ideas in terms of time
DN4	I do not get stuck on a set of rules to solve a problem
CN4	I am self-motivated to solve self-defined problems

The KMO and Bartlett tests showed favourable values with KMO in excess of 0.80 in all three rounds while improving the variance explained from 63% to 66%. The Bartlett test of sphericity also remained below the required 0.000 level.

The purified data sets were then finally subjected to the exploratory factor analysis to determine the factors and their respective measuring criteria pertaining to creativity at tertiary educational level. The factor analysis revealed twelve factors that could be identified from the data. The cumulative variance exceeds the required 60% level at 66% and represents a "good fit" of the data (Field 2007:668). The identified factors have been labelled and interpreted appropriately. The number of each factor corresponds with the factor number in Table 2. The table also shows the variance explained by each of the factors as well as the cumulative variance and Cronbach Alpha coefficients (reliability).

Table 2 shows the factors and items that loaded onto the twelve factors. Factor loadings range from minus one (perfect negative correlation) to plus one (perfect positive correlation). The higher the factor loading (either positive or negative), the more strongly that item is associated with the corresponding factor, and resultantly shows a more relevant position in definition to the factor's dimensionality (Hall 2013:1).

Twelve factors were identified based on the purification of the measuring instrument and the reliability of the data to include in a model to measure creativity.

Based on the content of the correlated items, a name or label was developed for each underlying factor. The factor then became the theoretical framework for explaining creativity at tertiary educational level. The twelve factors are:

Factor 1: Challenging the Status Quo

Factor 1 is the major factor and has been identified as *Challenging the status quo*. The five items loading onto Factor 1 point to an individual's willingness and motivation to challenge assumptions, to take initiative, to look at the big picture, being creative in an environment that tears down personal barriers to creative thinking and being motivated to be creative in his/her own interest areas. The factor explains a favourable variance of 7.72%.

Factor 2: Detachment

Factor 2 has been identified as *Detachmen*t. The four items loading onto Factor 2 all point to the ability to separate processes, resources, objects and dimensions in an effort to be creative. The factor explains a variance of 6.68%.

Factor 3: Synthesis

Factor 3 has been identified as *Synthesis*. The four items loading onto Factor 3 all point to the ability to combine processes and to look for uniqueness and similarity in processes to help

Table 2: Factor loadings

Creativity items	*Factor loading per factor*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
kn7 - I like to challenge assumptions	.729											
kn6 - I like to take initiative and challenge assumptions	.729											
cn5 - I am always motivated to be creative in my own interest areas	.674											
kn5 - I always look at the big picture	.546											
cn6 - I am motivated to be creative in an environment that tears down my barriers to creative thinking.	.528											
a5n2 - To find creative solutions, I separate processes		.765										
a5n3 - To find creative solutions, I separate resources		.742										
a5n4 - To find creative solutions, I separate objects		.654										
a5n5 - To find creative solutions, I separate dimensions		.632										
a4n3 - To find creative solutions, I combine processes			.754									
a1n1 - To help me find solutions or generate ideas I look for the uniqueness in processes			.674									
a4n2 - To find creative solutions, I combine concepts			.626									
a7n5 - I look for similarity in processes			.578									
dn2 - I can discover different links and relationships (obvious and not so obvious) when I look at different information sources				.769								
dn1- I attain understanding from a variety of information sources without difficulty				.728								
dn3 - I can cope with complexities when I need to resolve a problem				.715								
kn1 - I generate new ideas by actively searching for associations among concepts					.724							
kn2 - I use brainstorming to make associations regarding a given concept.					.636							
fn1- I propose new ideas on a regular basis					.622							
kn3 - I make the effort to actively search for associations					.526							
en1 - I am able to persuade others that my ideas are valuable					.460							
dn6 - I can recognise gaps in my existing knowledge						.696						
dn4 - I do not get stuck on a set of rules to solve a problem						.667						
dn5 - I can easily see different aspects of a problem						.621						
dn7 - I can recognise gaps in my existing knowledge						.570						
a7n2 - I look for similarity in problems							.748					
a7n3 - I look for similarity in solutions							.712					
a7n4 - I look for similarity in patterns							.616					
a7n1- I look for similarity in concepts							.557					
cn2 - I am driven by external pressures (including other people) to solve self-discovered problems								.760				
cn1- I am driven by external pressures (including other people) to solve problems								.708				

Table 2: Contd...

Creativity items	*Factor loading per factor*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
fn2 - I intentionally engage in unpopular ideas								.595				
hn1 - I am a sensitive person									.858			
hn3 - I am sensitive to the various aspects of a problem									.832			
a8n3 - To find the best creative solution, I experiment										.769		
a4n1 - To find creative solutions, I combine concepts										.720		
a2n3 - I consider the dimensionality of an issue to create ideas in terms of cost											.749	
a2n2 - I consider the dimensionality of an issue to create ideas in terms of time											.662	
jn4 - I make random attempts to solve a difficult problem												.882
Variance explained	7.722	6.680	6.461	6.245	6.225	6.225	5.848	5.012	4.762	4.041	4.014	2.930
Cumulative variance explained	7.722	14.40	20.86	27.11	33.34	39.56	45.41	50.42	55.18	59.22	63.24	66.16
Cronbach alpha	0.753	0.741	0.737	0.768	0.755	0.735	0.737	0.625	0.751	0.559	0.597	***

find solutions or generate ideas. The factor also points to the ability to combine concepts to find creative solutions. The factor explains 6.46% of the variance.

Factor 4: Cognition

Factor 4 has been identified as *Cognition*. The three items loading onto Factor 4 all points to the ability to discover links and relationships by looking at different and a variety of information sources, as well as the ability to cope with complexities when a problem needs to be solved. This factor explains a favourable variance of 6.25%.

Factor 5: Associate And Communicate

Factor 5 has been identified as *Associate and Communicate.* The five items loading onto Factor 5 points to the ability to generate new ideas by looking actively for associations among concepts, the use of brainstorming to make associations, to propose new ideas regularly and the ability to persuade others that creative ideas generated are valuable. This factor explains a favourable variance of 6.23%.

Factor 6: Awareness

Factor 6 has been identified as *Awareness* The four items loading onto Factor 6 points to the ability to recognise gaps and contradictions in existing knowledge, to see different aspects of a problem and the ability to not get stuck on a set of rules to solve a problem. This factor explains a variance of 6.23%, the same as Factor 5.

Factor 7: Similarity

Factor 7 has been identified as *Similarity*. The four items loading onto Factor 7 all point to the ability to look for similarities in problems, solutions, patterns and concepts. This factor explains a variance of 5.85%.

Factor 8: External motivation

Factor 8 has been identified as *External motivation*. The three items loading onto Factor 8 all point to the impact of external pressures and people to solve problems and to intentionally engage in unpopular ideas. This factor explains a variance of 5.01%.

Factor 9: Sensitivity

Factor 9 has been identified as *Sensitivity*. The two items loading onto Factor 9 all point to the sensitivity of a person to various aspects of a problem. The actual loadings of the two items are very close and differ with 0.03. This factor explains a variance of 4.76%.

Factor 10: Experiment and Combine

Factor 10 has been identified as *Experiment and Combine*. The two items loading onto Factor 10 point to the ability to find the best creative solution by experimenting and combining objects. The actual loadings of the two items are particularly close and differ with 0.05. This factor explains a variance of 4.04%.

Factor 11: Dimensional Thinking

Factor 11 has been identified as *Dimensional Thinking*. The two items loading onto Factor 11 point to the ability to consider the dimensionality of an issue to create ideas in terms of cost and time. The lowest loading refers to the consideration of the dimensionality of an issue to create ideas in terms of time and the highest to the consideration of the dimensionality of an issue to create ideas in terms cost. The actual loadings of the two items differ with 0.9.The factor explains a variance of 4.01%.

Factor 12: Problem-solving

Factor 12 has been identified as *Problem-solving*, since the item loading on Factor 12 point to random attempts to solve a difficult problem. Only one item loads onto Factor 12, albeit with a high loading of 0.88. This factor explains a variance of 2.93%.

The identified 12 factors highlights that creativity can be measured, however it remains complex due to the consideration of specifically the cognitive psychology and personality characteristics of individuals, as well as the external influences and its impact on the development and support of creativity.

Reliability of Data

Factors 1-7 and 9 all have satisfactory reliability coefficients in excess of the required 0.70. Factors 8 and 11 is below the higher reliability coefficient of 0.70, but above the lower limit of 0.57 set by Cortina, and is thus accepted to be reliable factors. Factor 10 is marginally lower that the lower limit of 0.57 set by Cortina with a secondary acceptable reliability coefficient of 0.56, and in that context, this factor might not present itself in repeated research. However, this fact does not make a factor less significant to the current study, and as such this factor should be interpreted with this possible constraint in mind (Field 2007:668-669).

It became evident from the explained variance of each factor that challenging the status quo and cognitive processes like detachment, synthesis, cognition, awareness and associate and communicate are very important to measure creativity as it explained the highest variance (above 6%). The high factor loadings (which ranges from .882 to .460) and the goodness-of-fit as depicted by the cumulative variance of all twelve factors (in excess of 60%) confirm the preceding findings.

The factor analysis identified the criteria pertaining to each factor, and as such, these criteria are statistically proven to measure the specific factor. The variance explained by these factors is also calculated, thus showing the relative importance of each of the factors and its respective criteria's relevant value to the measuring instrument.

CONCLUSION

Measuring creativity at a tertiary educational level has been problematic due to diverse teaching and learning processes and programmes used at tertiary educational institutions. The objective of this article was to develop and assess a tool that was created to assist in measuring creativity at a tertiary educational level. In doing so, a literature study of creativity was embarked upon to identify the underlying variables used to measure creativity. Various approaches, models and common indicators of creativity were explored. This article highlights specifically the Torrance Test of Creative Thinking (TTCT), the conceptual map of creativity in teaching and learning, the Educational Model of Creative Development (PECEI) and the Amusement Park Theoretical (APT) model.

The identified variables were then subjected to a factor analysis process and the reliability of the data tested.

Twelve factors were identified, namely: challenging the status quo, separate, synthesis, cognition, associate and communicate, awareness, similarity, external motivation, sensitivity, experiment and combine, dimensional thinking and problem-solving.

The above factors represent key elements in the creation of a measuring instrument that can be utilised to measure creativity at tertiary educational institutions, specifically in South Africa, and they possess the potential to be applied and tested in various settings as well.

It is recommended that educational development should measure the creativity of students using the 12 factors identified and then development right brain activities to develop and enhance creativity to ensure that students are prepared to deal with the challenges and problems of the future. The educational environment should further be encouraged to favour both divergent and convergent thinking and not impede the development of creative ability. It is also recommended that the TTCT tests should still be considered in education as it can be seen as valid predictors of creative achievement due to the focus on constantly improving the test's validity.

The researcher acknowledges, that measuring creativity at tertiary educational level remains a challenging undertaking. The reasons for that are that psychological factors are key determinants in fostering or inhibiting creativity at tertiary educational concomitant, with the relative impacts of social and cultural factors on creative and teaching processes in diverse academic disciplines in different countries.

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REFERENCES

Allen KR 2012. *New Venture Creation*. 6th Edition. Mason: South Western Cengage Learning.

Baer J, Kaufman JC 2005. Bridging generality and specificity: The Amusement Park Theoretical (APT) model of creativity (theoretical and interdisciplinary perspectives). *Roeper Review*, 27: 158-163.

Bronson P, Merryman A 2010. The Creativity Crisis. *Newsweek*, 19 July, pp. 21-25.

Field A 2007. *Discovering Statistics Using SPSS*. London: Sage.

Fields Z 2012. *A Conceptual Framework to Measure Creativity at Tertiary Educational Level*. Ph D Thesis, Unpublished. Potchefstroom: North-West University.

Fields Z, Bisschoff CA 2013. A theoretical model to measure creativity at a University. *Journal of Social Sciences*, 34(1): 47-59.

Hall S 2013. How to Interpret Factor Analysis. From <http://www.ehow.com/print/how_ 5376480_interpret-factor-analysis.html> (Retrieved September 13, 2011).

Jackson N 2006. Creativity in Higher Education – creating tipping points for cultural change. *SCEPTrE Scholarly Paper*, 3: 25.

Karpova E, Marcketti SB, Barker J 2011. The efficacy of teaching creativity: Assessment of student creative thinking before and after exercises. *Clothing and Textile Research Journal*, 29(1): 52-66.

Kim KH 2006. Can we trust creativity tests? A review of the Torrance Tests of Creative Thinking (TTCT). *Creativity Research Journal*, 18 (1): 3-14.

Kleiman P 2008. Towards transformation: conceptions of creativity in higher education. *Innovations in Education and Teaching International*, 45(3): 209-217.

Livingston L 2010. Teaching creativity in Higher Education. *Arts Education Policy Review*, 111: 59-62.

Perez Alonso-Geta PM 2009. Researching, Measuring and Teaching Creativity and Innovation: A Strategy for the Future. Institute of Creativity and Educational Innovation, University of Valencia. From <http://ec.europa.eu/education/lifelong-learning-policy/doc/creativity/report/research.pdf> (Retrieved June 15, 2010).