INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
7 & 8 SEPTEMBER 2017, OSLO AND AKERSHUS UNIVERSITY COLLEGE OF APPLIED SCIENCES, NORWAY

MEASURING CREATIVITY

Ingeborg STANA
Associate Professor, Department of Art, Design and Drama, The Faculty of Technology, Art and Design, Oslo and Akershus University College of Applied Sciences

ABSTRACT
This article examines the various models used to measure creativity amongst learners and teachers in higher education; it also discusses fundamental insights to guide educators in measuring creativity. To attain this objective, the article reviews the 2012 research publication 'Progression in Creativity: Developing New Forms of Assessment' that is based on two British qualitative field studies by Spencer, Lucas and Claxton [3].

Keywords: Creativity, creative thinking, entrepreneurship, evaluation methods, innovation, intelligence, problem solving, teaching methods.

1 INTRODUCTION

Creativity has become a topic of great global interest, evidenced by the increasing number of researchers, academics and consultants studying, evaluating, publishing and talking about the issue. We are constantly presented with analyses of the importance of creativity. In the book *Mass Flourishing: How Grassroots Innovation Created Jobs, Challenge and Change* [1], Nobel Prize-winning economist Edmund Phelps shows that innovation and creativity are the sources of prosperity and the future of capitalism. To maintain Western culture, Phelps argues, it is important to develop independence, individual initiative and creative abilities. 'Create or die' [1] is a motto that applies not only to artists, but also to businesses, individual entrepreneurs and governing politicians. In other words, change and renewal have become important social values.

Far from ensuring the ease of developing a structure to evaluate creativity, the use of the term, in reality, made it quite difficult. This is mainly attributable to the fact that definitions of creativity are quickly expanding, even as the term is increasingly being utilised to cover divergent areas of both human activities and behaviours. According to Catterall and Runco [2], creativity is a complex concept, making a universally accepted definition neither appropriate nor feasible. This is a consequence of the fact that the widely important definitions are, to a given degree, simply a set of attributes belonging to the process of creativity; they are purposeful and imaginative, and their results tend to be valuable and original. Amongst the notable advantages of creativity are adaptive problem resolution, independent thinking and success when faced with novel and unanticipated challenges. Moreover, creativity has become a major requirement of academic research, as it encourages researchers to ask novel questions and find inventive answers. Thus, a creative learning milieu enhances the freedom of thinking amongst the participating tutors and learners, stimulating the amalgamation of divergent aspects in novel, unanticipated, useful and interesting ways. The main objective of the present article is to review and give an overview of the various models used to measure creativity in higher education contexts. To attain this objective, the article reviews 'Progression in Creativity: Developing New Forms of Assessment' [3] by Spencer, Lucas and Claxton. Creativity, Culture and Education (CCE) commissioned the Centre for Real-World Learning (CRL) at The University of Winchester to undertake research to establish the viability of creating an assessment framework for tracking the development of creativity in schools. In this context Spencer, Lucas and Claxton worked to develop a language of creativity and defines behaviours and skills that teachers value. The researchers argue that when teachers have an in-depth understanding of creativity, they are more capable of promoting creative skills in students. Further, they report that students who understand the basic concept of creativity are more able to cultivate creative skills and oversee their own development.

2 HOW TO MEASURE CREATIVITY

With the current technology of functional MRI and PET scanning, neuroscientists have begun to measure how creativity arises. A study at Stanford University [4] reveals that the source of creativity is in the clump of nerve cells located in the cerebellum under the big brain. The survey proves that analytical and critical thinking occur in the frontal lobes (the cerebrum) and are inhibited from working freely with solutions, ideas and associations. However, synergy may arise in the form of switching between the higher cognitive brain and the cerebellum. Depreciation and wiring comprise the engine that drives thought development. The senior author of the study, Professor Allan Reiss, points out that creativity applies not only to achieving good results in productive work, art and science, but that it also plays a significant role in interpersonal relationships. In order to better understand the opportunities and challenges for learning in a contemporary context and the 21st century teaching activities, it is essential to explore this link between developing creativity and interpersonal relationships.

In a study that more precisely measures creativity amongst students in higher education, Thomas and Chan [5] investigates creativity in diverse fields including art, aesthetics, creative industries, design, new media, engineering and technology. They report that a number of categories and models can be used to assess a creative product, individual, potential and place featuring a variety of disadvantages. In their research they examines critically loose concepts of creativity and cases where creativity does harm. However, the emphasis on the creative person and his or her temperament calls for the use of a creativity assessment model that captures instances of such predispositions as they occur in real time. Thomas and Chan challenge the myth of solitary genius, by documenting the social and cultural systems within which new ideas emerge. Professor Kusuma [6] also calls for an assessment model that uses adequate descriptors propped up using examples, portfolio-based assessments, self-assessments and peer assessments as well as studies that utilise mixed methods. As such, one of the models proposed by Parker [7], former Director of Research at Creativity, Culture and Education (CCE), is the assessment for learning (AfL), which diverges from the common model that uses value tests via pen-and-paper measurements to acquire assessment data. Amongst the notable benefits of AfL is that in spite of being a formative approach to learning, the model is sustained by a larger body of research and practice. Based on this observation, Spencer, Lucas and Claxton [3] favoured AfL when they developed the trial tool used in their tests to determine the most effective model for measuring creativity.

Sefton-Green, Thomson, Jones and Bresler [8] acknowledge that schools tend to have different experiences with regard to creativity assessments and the models used to conduct the measurements. A number of school administrators feel that it is wrong to attempt to summatively measure creativity, whereas others tend to be agonistic about such approaches; this results in a variety of positive and negative experiences from attempts to measure creativity. Individuals who oppose summative measurements of creativity prefer creativity measurement models that support learners' formative learning in addition to supporting more effective teaching by ascertaining clarity about what is found in creative learning and the scope of creativity. Therefore, individuals who are agonistic about summatively measuring creativity have concerns about the challenges of evaluating the creativity progress in a reliable way. They also fear that the data produced through summative assessment may be utilised comparatively in the development of a league table of creative institutions. Several schools use creativity measurement models that mesh with their general approach to creativity evaluation; however, there is no single institution that has been able to acknowledge any extant model that is completely satisfactory. Thus, every school tends to acknowledge the value of creating a formative measurement model as well as a creativity measurement model that attempts to raise their creativity status.

To effectively realise the aforementioned needs, Spencer, Lucas and Claxton [3] developed a three-dimensional creativity measurement model capable of tracking learners' development in terms of its depth, breadth and strength. According to the model, strengthening regards becoming less dependent on tutors' scaffolding and prompts. In contrast, broadening entails exercising various creative habits within novel contexts through the transfer of habits into domains. Lastly, deepening concerns exercising these habits and becoming increasingly complex and apt to the occasions. Theoretical underpinning for defining and assessing creativity goes along with a number of practical suggestions as to how creativity can be developed and tracked; activity requiring a range from creativity as an individualised endeavour to creativity as a collective phenomenon. According to Spencer, Lucas and

Claxton two clear benefits of assessing progress in the development of creativity are identified in the classroom. On one hand teachers are able to be more precise and confident in developing young people's creativity, and on the other hand learners are better able to understand what it is to be creative.

Even though the models that Spencer, Lucas and Claxton [3] advanced have been highly effective in measuring creativity amongst learners and teachers, several other models have been proposed in higher education. One notable creativity measurement model found to be effective is the taxonomy of creative design. According to Silton [9], this taxonomy mainly refers to alterations in both content and form of the previous model [3] and might be used to assess innovativeness as well as derivations of imaginative work. Catterall and Runco [2] point out that the taxonomy of creative design tends to perceive creative work as a product in addition to categorising creative work as another work's imitation, a single work's variation, a combination of more works, an alteration of a work into a totally novel form or the creation of a work that has not been previously recognised. The taxonomy of creative design requires a scientific reduction approach to a creative work in order to comprehend the 'parts' component. The use of taxonomy enables work analysis within the antecedent's context by seeking solutions to questions like 'How far is the creative work from earlier works?' and 'How great is the leap taken by the creator with regard to content and form?' These questions enable researchers to measure the creativity of a work in addition to the creativity of a given solution by determining where the novel work fits within the taxonomy of creative design. The more original the work is with regard to content and form, the more creative it is. The categorisation can be further explained using the following measurements:

1. Imitation: the development of a similar or almost similar product as one in existence.
2. Variation: the making of slight alterations to the existing object in a way that makes it look different despite being able to maintain the original object's identity.
3. Combination: the mixing of two or more products to an extent that that they can be described as either 'all' or 'both'.
4. Transformation: the recreation of a product in a novel milieu to an extent that it acquires a number of the original product's attributes. Nevertheless, it cannot be referred to as the original product.
5. Innovative creation: the creation of a product that seems to have no single discernible quality of any existing idea or object.

By using the above questions, the taxonomy of creative design has been an effective evaluation instrument for measuring a product's/object's originality. Amongst the notable strengths of the taxonomy is its capability to evaluate creative works in relation to other existing works by measuring their originality and influence. However, amongst its key disadvantages is that it cannot measure the value of greatness, the difficulties, that learners experience; rather, it measures how far the product goes with regard to earlier works in addition to a number of mechanics on how such gains were realised. Another notable weakness of the taxonomy is that it illustrates nothing about the work's value, pertinence or efficiency. Thus, for teachers, the taxonomy functions as a planning tool, as it proposes several types of creative assignments and activities that learners may participate in. For measurement purposes, it is recommended that these activities should be selected based on comprehensive programme needs.

Another notable measurement framework is the requirements model. Here, the assessment of creative work is founded on criteria established prior to the making of the product. For instance, according to Sefton-Green, Thomson, Jones and Bresler [8], in architecture, a house design normally commences with the programme's necessities: the number of bedrooms, the kitchen style, cost restrictions, effective utilisation of space and light and the feeling of openness or cosiness, among others. These represent intentional needs, boundaries and restrictions within which an architect is required to develop a novel plan. Upon completion, a number of assessments are straightforward, for instance, the appropriate number of rooms, the style of the kitchen and the completion of the project within the budget. Other measurements are somewhat more intricate, such as the cosiness and openness of the house as well as the efficient use of space. In spite of these seemingly increasingly subjective measures, they can indeed be measured concretely. For instance, cosiness and openness may be evaluated by asking 'What amount of light gets into the rooms?', 'Do clear lines of sight exist in the

spaces?' and 'What is the height of the ceilings?' Beyond just contributing to the sense of openness, these questions are straightforward, clear and quantifiable. Moreover, responding to such queries provides a direct assessment of the abstract programme needs. As such, one may be able to straightforwardly assess a creative product if he or she has set meticulous requirements. Many feel that creative work should fall within the realm of aesthetic subjectivity; however, a number of subjective and aesthetic responses originate from discrete information pieces that can be measured. Thus, the requirements model proposes that the identification of such discrete information components is the key to the objective measurement of creativity. Amongst the notable advantages of the requirements model is that it is capable of measuring pertinence, efficiency and value against noticeably stated sets of requirements. The key disadvantage of the model is that it works in instances where a work is being compared against itself, as opposed to other works.

It is worth noting that the specific challenge of performing measurement, particularly in higher education, lies in clearly setting programme requirements. This implies that in instances where the assignment is placed on the taxonomy of creative design, the more necessary it is for the variation or imitation model to be clearly defined. If an assignment demands the creation of variations of epic similes by a learner, the various aspects and components of the epic simile have to be clearly defined. The higher the assignment is on the taxonomy, the greater the need to apply external requirements so as to ensure that the measurement is straightforward, as can be observed in the above architecture example. By asking a learner to design a house, one is bound to experience difficulties measuring the outcomes. However, if the learner is asked to design a house for a four-member family in a suburban plot making the most of sunny weather and offering easy access to the disabled, then the measurement will be increasingly easy.

Csikszentmihalyi's systems model is another preferred tool for measuring creativity in higher education, as it examines the work's social value. Psychologist Csikszentmihalyi [9] proposes that a work's value can be found in the relations between three key parties: the person or the work, the other individuals involved in the work and the class to which the work belongs. The parties fall broadly under three major categories: the person, the domain and the field. According to Csikszentmihalyi, the 'person' may refer to the individual work, the person and the body of work, while the 'domain' may imply the knowledge area or genre (e.g. rock music or painting). The 'field' refers to the domain's gatekeepers or authorities and may include individuals like critics and other artists. Csikszentmihalyi points out that creativity can be defined as what occurs when an individual develops a piece of work or product that is embraced by the field, causing the domain to change as a result. For instance, Thomas and Chan [5] describe a scenario in which a writer pens a novel that tends to enhance the reader's understanding of novels; the field is made up of critics, other writers and consumers who embrace it. In these circumstances, it is considered as a work of creativity. The value of creativity is based on both the cultural and social responses toward a work. Thus, according to Csikszentmihalyi, being creative implies more than a mere provision of any old and dissimilar production. The model prohibits calling a piece of work creative [9]. The approval of the field is vital, and upon creating a piece of work, the field is used as the main determinant of whether the product/piece can be held within the domain or if it will pass into obscurity. The key advantage of Csikszentmihalyi's model is that it evaluates the pertinence and value of a work by considering the community context [7]. A notable disadvantage is that the model can be subjective. As a cultural and social tool, the model is based on constantly changing parameters; thus, the field tends to change with time, even as works emerge and disappear into anonymity. As such, Silton points out [9] that the works' or products' measurements do not present absolute values, but instead they are measured by their appearance in the consciousness of the domain. For example, by changing rock music, Elvis Presley and the Beatles will most probably remain an important part of the rock and roll domain whenever individuals discuss rock and roll music's history. Even though the Turtles wrote a number of great music pieces that led to them being heralded highly during their times, they might have not only faded out of the consciousness of the domain, but also settled into the domain's recesses as their involvement in the field weakened.

Lastly, the Guilford measures has been utilised widely in measuring the creativity of learners. The model mainly measures an individual's creativity. Guilford, a psychologist, developed four key measures focusing on students' diverse productions [8]. Every measure may be enhanced and

practiced, and they all concentrate on creative output with regard to prompt context-seeking in a quantity of answers. The model measures fluency, elaboration, flexibility and originality. With regard to fluency, the model measures the amount of the responses. It measures the kinds of responses to evaluate flexibility. Originality is measured based on the responses' unusualness. Finally, elaboration evaluates the responses' details. Similar to the other models discussed above, the Guilford measures is not all-inclusive in evaluating creativity; it realises a certain type of individual psychometric assessment by measuring the productivity quotient type in cases where that is what an individual is aiming to achieve. The notable advantage of the Guilford measures, according to Catterall and Runco [2], is that it evaluates the output of productivity in a vivid and quantifiable manner. Its main disadvantage is that it does not reveal anything about a work's pertinence or value in terms of its creative output. Guilford and other psychologists have greatly expanded on these introductory measures in the creation of a full creativity test battery that includes more refined categories. For example, psychologist Ellis Torrance has developed a sequence of tests that build on Guilford's work called the Torrance tests of creative thinking (TTCT). It evaluates divergent thinking and other problem-solving skills that are used to measure every category either visually or verbally.

3 CONCLUSION

The objective of this article was to demonstrate that it is far from impossible to measure creativity, and that such scepticism should be set aside. There is no single preferable model of measuring creativity owing to the divergences in the definition of creativity and the fact that different models measure different aspects of a work; thus, this article recommends that institutions use a combination of models in their evaluation processes. It is very possible for institutions to develop accurate and constructive ways to measure creativity within their defined fields. Moreover, it is recommended that they incorporate goal setting and reflection as important components in the teaching and measuring of creativity. Learners require time to observe the indicators of quality and reflect on their progress toward mastery in a field. As such, they should be encouraged to set goals based on quality indicators and create plans for how they will accomplish these goals. These reflective and metacognitive processes will assist students in the development of critical thinking abilities, and they should be utilised at every stage of the process.

REFERENCES

[1] Phelps, E., *Mass Flourishing: How Grassroots Innovation Created Jobs, Challenge, and Change*, 2014 (Brilliance Audio).

[2] Catterall J. S. and Runco M., *Next Generation Creativity Survey V.3.1.2: Measuring Creative Behaviour and Motivation in the Arts and Sciences*, 2014 (Createspace Independent Pub, North Charleston, South Carolina).

[3] Spencer E., Lucas B. and Claxton G., *Progression in Creativity: Developing New Forms of Assessment*, 2012 (Creative, Culture and Education, and Centre for Real World Learning, Newcastle, UK).

[4] Saggar M., Quintin E-V., Kienitz E., Bott N. T., Sun Z., Hong W-C., Chien Y-H., Liu N., Robert F., Dougherty R. F., Royalty A., Hawthorne G. and Reiss A. L., Pictionary-based fMRI paradigm to study the neural correlates of spontaneous improvisation and figural creativity. *Scientific Reports 2015*, 5(article no. 10894). doi: 10.1038/srep10894.

[5] Thomas K. and Chan J., *Handbook of Research on Creativity*, 2013 (Edward Elgar Publishing, Cheltenham).

[6] Kusuma A., *Creativity And Cognitive Styles in Children*, 2010 (Discovery Publishing House, Grand Rapids, MI).

[7] Parker D., *Creative Partnerships in Practice: Developing Creative Learners*, 2013 (A&C Black, London, United Kingdom).

[8] Sefton-Green J., Thomson P., Jones K. and Bresler L., *The Routledge International Handbook of Creative Learning*, 2011 (Routledge, London).

[9] Silton N. R., *Exploring the Benefits of Creativity in Education, Media, and the Arts*, 2016 (IGI Global, Hershey, PA).