

# Creativity in the Digital Forensics Curriculum

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**Keywords:** Teaching Creativity, Higher Education, Digital Creativity.

**Abstract:** Creativity is defined in the Oxford Dictionary as "The use of imagination or original ideas to create something". This definition is easy for students studying topics commonly recognised as creative, such as animation, drawing, photography and design, to put in context and understand. However, when studying topics commonly recognised as technical, such as computer science and digital forensics, it's not as easy for students to relate to this definition. One of the affiliated universities offers bachelor programs in several disciplines and through the first course, the university is trying to establish a common ground of studying for all students regardless of the program they are attending. One of the modules in this first course is called "What is Creativity?" but the digital forensic students do not seem to relate creativity to the topics contained in their own study program, and it has been challenging to get these students to see the relationship between creativity and the work situation they might find themselves in after they graduate. This paper will discuss the challenges of teaching creativity to students in perceived technical programs – and try to highlight the challenges experienced from both students and staffs point of views.

## 1 INTRODUCTION

There is a general conception that creativity is now a necessary part of learning outcomes in higher education, not just as part of "artistic" subjects, but as a general attribute expected to be included in any higher education degree (Pollard, 2012). It has been claimed that one of the reasons for this eager approach to implementing creativity in education is driven by an increased capitalism across the globe (Craft, 2006), a view also supported by Pollard (2012) who states that "...creativity has become central to the effort to increase economic productivity..." Other reasons are the fact that for instance technology is being developed at such high rate that what we buy today, might very well be totally outdated tomorrow (Csikszentmihalyi, 2006) and the best diet of today might be claimed unhealthy tomorrow (Csikszentmihalyi, 2006). In addition, Amabile (1988) suggest that there is a strong correlation between creativity and innovation.

This paper will discuss the challenges experienced when teaching creativity to Digital Forensics students. Students in Interactive Media and other perceived artistic study programs, of course, find it easy to grasp the concept of creativity – as they

are studying subjects that most people perceive as creative. The situation is very different with the Digital Forensics students and other perceived technical study programs, who seems to fail to see the need for creativity in the very technical industry they will be entering after graduation. It will also consider the reasons and explanations for this difference.

## 2 THE FIVE FUNDAMENTAL INSIGHTS

The basis for the discussion in this paper will be the five fundamental insights that Ronald A. Beghetto and James C. Kaufman published in February 2013 in order to help educators incorporate creativity in academic learning (Beghetto and Kaufman, 2013).

### 2.1 Creativity Takes More than Originality

In order to teach creativity, educators must know what creativity actually is. Beghetto and Kaufman (2013) states that there is a general agreement that creativity is a "combination of Originality and task

*appropriateness.*” This definition is supported by the National Advisory Committee on Creative and Cultural Education, led by Professor Ken Robinson, who provided the following definition of creativity:

Creativity is an imaginative activity fashioned so as to produce outcomes that are both original and of value.” (National Advisory Committee on Creative and Cultural Education, 1999)

Plucker et al (2004) provide an interesting definition, suggesting that creativity is “*the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context*”. Others such as Salgian et al (2103) consider that “*creativity in Computer Science is different from creativity in the arts*”.

One challenge with this is the obvious contradiction that something must be original but at the same time fulfil requirements to be deemed of value or appropriate (Beghetto and Kaufman, 2013). A more specific challenge in our case is the different perceptions an animation artist and a digital investigator have on the word creativity, and therefore the different attitudes they have towards a learning journey involving creativity. The value and appropriateness of the learning activities and lectures is of the utmost importance to engage both cohorts of students, primarily make the digital forensics students see the importance of creativity without losing the interest from for instance interactive media students.

## 2.2 There are Different Levels of Creativity

Beghetto and Kaufman (2013) describes different levels of creativity, from everyday creativity to life-changing creativity, and this is perhaps the first thing that we need students to realise. Creativity does not have to involve becoming the next Picasso or Da Vinci, in fact, it does not have to do with art at all. Kaufman and Beghetto (2009) divides creativity into the four levels mini-c, little-c, Pro-C and Big-C and describes them as:

**Mini-c:** interpretive creativity (for example a Digital Forensic student discovery of how to use an acquisition tool)

**Little-c:** everyday creativity (for example Digital Forensics class doing a project that combines learning about interpreting traffic in a network analysing tool by collecting network traffic from the local network)

**Pro-C:** expert creativity (for example Digital Forensics students creating a new tool for data acquisition)

**Big-C:** legendary creativity (for example teachers revolutionising the implementation of learning creativity in all study programs in higher education)

Getting the Digital Forensics students to see the relationship between what they do as forensic investigators and interpretive and everyday creativity is essential to get them motivated enough to participate and engage in the creative learning. Motivation has been shown to play a major role in students’ willingness to learn technical subjects such as programming (Jenkins, 2001), but it would be equally important for us to create academic emotions (Pekrun et al, 2002) that promote motivation among several cohorts of students.

## 2.3 Context Matters

Earlier research has shown that creativity will not be at its best when under pressure. Rewards, conditions, competitive circumstances or personal stress (Amabile and Pillemer, 2011) are all elements to create pressure. Personal experience of the authors indicates that tasks and assignments given in educational settings are often set in order to achieve the learning outcomes of a course. The prize, in the end, could be a good grade, and it may also involve criticism and social comparisons among the students. Even so, it is possible for the students to look at assignments and tasks from a point of view that does incorporate their own interest and engagement, making the assignments meaningful and joyful for each individual student, since this is the situations where people are most creative (Hennessey and Amabile, 2010). This is also in line with Beghetto and Kaufman (2013) who states that “*teachers should help students focus on the more intrinsically motivating and personally meaningful aspects of the work by discussing how students might incorporate their personal interests into the tasks*”.

## 2.4 Creativity Comes at a Cost

If you do a search on Google for creativity (Figure 1) you will get a lot of pictures with colours and playful images.

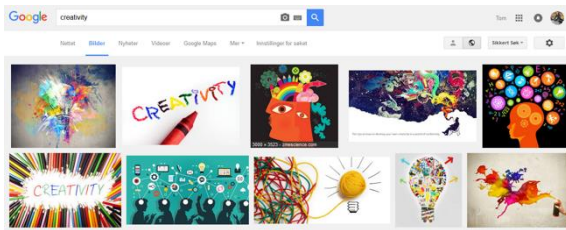


Figure 1: A google search for pictures of creativity.

However, academics in a survey spanning three countries and thirty participants claimed that they aimed for students to go beyond their own boundaries, taking risks and experiment (Morgan, 2012). This is also the experience one of the authors has had undertaking a BSc program in Product Design, where the students throughout the three years of study were pushed outside their comfort zone by sharing their project results for peer assessments and critiques. The risk of having something one have worked on and developed a personal ownership for, be assessed, evaluated and possibly dismissed, misunderstood and ridiculed by peers and teachers, can be devastating to a student. This is, therefore, something the students must be made aware of (Beghetto and Kaufman, 2013). Getting the students in both perceived artistic study programs and perceived technical study programs to feel the necessary comfort to allow themselves to step out on a limb, take some risks and experiment, is important. It certainly also complies with the earlier mentioned survey, where stimulating motivation and enthusiasm among the students so they become willing to take risks and to know it is looked upon as positive to fail as long as one learns from it (Morgan, 2012).

## 2.5 There is a Time and a Place for Creativity

In this always available, always online world where things happen with increased speed followed by an increased need for “quick fixes”, governments have a mobilised interest (McWilliam and Haukka, 2008) and teachers perhaps feel the pressure to include creativity in all aspects of teaching (Beghetto and Kaufman, 2013). Even so, do we want creativity in all situations? The authors would rather that pilots flying us to holiday destinations follow all common procedures for that task than trying out some new creative moves. If something goes wrong, however, creativity to get us safely on the ground would be much appreciated. In addition to teaching creativity to digital forensics students, we should also teach them when creative solutions are appropriate,

although it is difficult to justify including more elements in an already heavy curriculum when professional bodies such as BCS/CSOFS do not include standards covering creativity in their accreditation schemes (csofs, 2016).

## 3 TEACHING CREATIVITY TO DIGITAL FORENSICS STUDENTS

The easy part in teaching creativity is to make students in perceived artistic study programs understand the importance of creativity. They already perceive what they do as creative topics. The challenging thing is to clarify for the students in perceived technical study programs that it is equally important for them to be creative. Creativity has in fact been mentioned as a “necessary requirement for United States prosperity and security” by the National Science Foundation (Karpova et al, 2011) (Schunn et al, 2006).

Again, there are different levels of creativity, and it does not all have to be life-changing events or even industry-changing events. But it does promote the opportunity of challenging two different type of student cohorts at different levels. In one of the courses focusing on creativity, two cohorts of students from an interactive media study program and a digital forensics study program are assessed through the same assignments:

- Reflective Journal: A blog (or similar) that describes their individual learning journey, interaction with other students, reflective thinking and progression.
- Mind Map: Showing an understanding of any chosen subject related to their field of study. The Mind Map is to be presented before fellow students (Figure 2 and 3).
- Research Article: Producing a professional-level article based on the Mind Map

This allows us to promote the motivation needed for both cohorts of students, interactive media students are given the opportunity to use colours and shapes to suit their perception of creativity, and the digital forensics students are given the opportunity to explore things they feel are appropriate to their field of study.

The pressure to achieve good grades, and perhaps also being compared with the other students during the presentation of the Mind Map (Figure 2 and 3) will, of course, be present, but the students are

encouraged to choose a topic of interest to maintain motivation throughout the process.

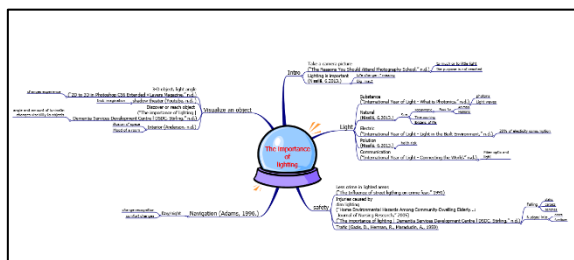


Figure 2: Mind Map from a Digital Forensics student.

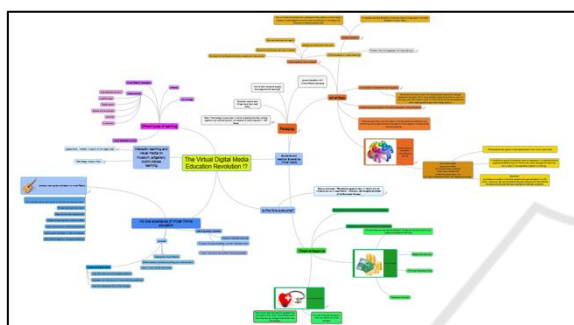


Figure 3: Mind Map from an Interactive Media student.

In another course that is also delivered to both cohorts of students, we focus on creating an environment in which the students feel comfortable enough to take the necessary risks to explore things in a manner they might not do otherwise. In groups, they are to choose a project of their interest regardless of their study program, and this project is carried out throughout the whole semester. Presentations of project proposals and work in progress are carried out at appropriate stages in the project period, in addition to the final result. The focus, however, is on the process along the way. With the knowledge that one can get a good grade in spite of a failed final result, will hopefully create the necessary "safety net" the digital forensics students perhaps feel they need in order to dare to take risks and put themselves "out there". Another way of comforting the students to believe in the projects is to point out that even the ideas not used – is an important building block towards the end-product. When several experiments had failed in Thomas Edison's quest to develop a commercially viable light bulb – he is said to have claimed that *"I have not failed 10,000 times. I have not failed once. I have succeeded in proving that those 10,000 ways will not work. When I have eliminated the ways that will not work, I will find the way that will work."* (Furr, 2011)

In another effort to expand creativity skills, a special event was developed for the students in the Advanced Cybersecurity module at the University of Sunderland. They were given access to the FabLab and the time and space to be creative and create a Cybersecurity "artefact". Students were given a very open brief asking them to use their knowledge of cybersecurity and their imagination to be as creative as they liked. Students were given the task a week in advance of going to the FabLab. At the FabLab students had three hours to develop their ideas into an artefact.

FabLab is based on the outreach project from Center for Bits and Atoms at MIT and incorporates the same core capabilities – such as CAD tools, 3D printers, sign cutters and laser cutting equipment (FabLab, 2016). Students were able to work individually or in teams and were supported by module tutors and FabLab staff.

Students came up with a variety of creative ideas ranging from devices to protect IT equipment including webcam covers and locks for USB ports to environmental control systems such as Wi-Fi blocking signal devices. They were able to start 2-d and 3-d drawings and use the facilities to "make" prototypes.

Feedback from the students was mixed and almost bi-polar in distribution. 46% of the students really enjoyed the opportunity to be creative and be in a different environment and make an artefact, whilst 42% didn't like the activity at all and didn't see the point in trying to be creative and make something for cybersecurity. The remainder were non-committal and did not have strong opinions one way or the other.

From a teaching perspective, it was an interesting way to introduce creativity into the cybersecurity curriculum and the activity will be run again in the future. However, on reflection, we should perhaps have done more in terms of discussing creativity with the students, given them more time to prepare their ideas and longer in the FabLab to bring their ideas to fruition and perhaps affect the negative attitude towards the activity among the 42% that did not see the point.

The fact that there is a time and a place for creativity need to be emphasised in both the preparations for a specific course or module and in the assessments in these type of modules and courses. We do not want the students to be creative in their effort to minimise the necessary workload, so a thorough specification as to what is expected of them need to be included in any course descriptors and/or assessment cover sheets.

## 4 CHANGES

Technology is rapidly changing in terms of both data storage, performance, shape and form. We see implementations of smart TVs, smart cars, smart homes, smart cities and a whole range of other smart devices, but for IT security and digital forensics students these things also present themselves as new challenges, as many of these so-called smart devices are not smart enough to stop cyber-attacks (Gail, 2016). Different organisations are trying to accommodate these changes by providing guidelines for educational programs within these fields, such as the National Security Agency (NSA, 2016) and the National Institute of Standards and Technology (NIST, 2016) in US, the Government Communications Headquarters (GCHQ, 2016) in UK and the Norwegian Agency for Quality Assurance in Education (NOKUT, 2016) in Norway. Although these are good initiatives, it seems that IT security and digital forensics related education is becoming the dog that is trying to catch its tail. When a new thing becomes an issue, guidelines are changed, but by the time the educational institutions have implemented the new guidelines, the new thing – is something entirely different. So, what to do when fridges and such are attacking us (BBC, 2016)? The authors of this paper are sure that it will come down to the creativity of some sort.

## 5 CONCLUSIONS

Both governments and academics have realised that if we are to base how we handle challenges on what we already know, the future tasks may well be overwhelming (Marquis and Henderson, 2015). Teaching creativity to digital forensics student is an important aspect of our universities' philosophy as the world is changing so rapidly that the technical expertise students train for today might not be sought after in near future (Csikszentmihalyi, 2006). We have to take into account that the kind of creativity that leads to life-changing innovations is more likely to be a result of someone putting together already existing thoughts and inventions in a new way rather than a completely unthought-of idea that appears out of nothing (McWilliam, 2007), and that we are "moving away from isolated geniuses" as Pollard (2012) put it. We feel that teaching the digital forensics students to see the relevance in everyday creativity, and to acknowledge that sometimes they need to take the risk of thinking differently about

technical challenges in order to figure out new ideas that have value to the digital forensics community (Pollard, 2012) and that this will be a solid competence to have after graduating. Lessig (2005) called it digital creativity and claimed that technology is "changing the way we remix culture, changing the creative potential of that culture, changing the democratic potential of that culture, changing the freedom to speak, by transforming the power to speak – making it different." We feel that the only way of teaching creativity to technical students in general, digital forensics students in particular, is to create an environment and learning activities where it is safe to use the freedom and power to speak and think different.

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