From Inventivity in Limerick to Creativity in Aveiro: Lessons Learnt

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Abstract. In this introductory chapter, we describe the key lessons from an earlier HCI Educators' conference, held in Limerick in 2006, the outcomes of which led to the theme of HCIEd 2007 – Creativity: Experiencing to Educate and Design. The paper discusses the lessons leant around four key questions: nature vs. nurture: can creative invention be taught; what tools and methods are there to help students learn to develop creative solutions; how do we train educators in creative invention; and what are the stumbling blocks to 'inventivity'?

1 Introduction

In this paper, we describe the key lessons from an earlier HCI Educators' conference, held in Limerick in 2006, on 'inventivity' – a term coined to highlight the confluence of inventiveness and creativity. There is a distinction between being creative and being artistic. HCI education, in terms of creative inventiveness, is not just about artistically pleasing user interfaces, but also about solutions that are innovative. We can know much about creativity and inventiveness. However, to be able to teach and train students so that they can be creatively inventive, we believe that it would be helpful if educators themselves have personally experienced this. With this in mind, we organised the follow-up conference HCIEd 2007 Creativity: Experiencing to Educate and Design.

Inventivity was coined to refer to the notion of inventing creative and innovative solutions. This term was also intended to mean that such solutions be more than 'creative', artistic or appealing interfaces as designed by artistic or 'creative types' of people. It was also intended to reflect the creativeness of the solutions that had to be invented. One reason for emphasising this aspect at the conference was that, in HCI design it is easy to mis-interpret the focus of HCI design solutions – which should not address just visualisation and interaction design, but also address how that visualisation and interaction creatively represents and simplifies the complexities in work that people engage in.

The recent focus on usability as the more tangible aspect of HCI has made the public, software developers and academics very aware of the problems caused by software with poor interfaces. While this is a good thing, it has perhaps also skewed our education of students in HCI as, resulting from this emphasis: most HCI courses have a significant focus on training our students to evaluate usability. This has led to the creation of a new industry in usability evaluation services. Although much more research is still needed for methods that improve usability, and that a better understanding and classification of usability problems can assist in the design of future products, such an approach, we believe, misses the other problem of a lack of methods for inventing better solutions and designs. If we have better solutions in the first place, there will be a lesser need to make limited improvements to software that has been delivered. In the Limerick conference, the emphasis was on understanding what is involved in inventing creative and innovative solutions, and therefore, how we might be able to teach this to our students.

One other assumption made during this conference was that human nature is such that we are creatures of habit and therefore we tend to follow the path of least resistance. This suggests that the more familiar we are with a particular way of working, the more likely we will stay with this approach, especially when we are under pressure to deliver an outcome. A person familiar with heuristic usability evaluation will most likely use that approach most frequently. Hence, if we as educators can develop such a familiarity amongst our students with the process and methods of inventing creative solutions, then they are also more likely to practise inventing creative solutions when in industry. It is against such a backdrop that we organised the conference on 'inventivity', and we used it to investigate the issues that helped or impeded teaching 'inventivity'.

Some of the issues that arose from the Limerick workshop concerning how we teach and educate our students 'inventivity', include:

a) Nature vs. nurture: can creative invention be taught?
b) What tools and methods are there to help students learn to develop creative solutions?
c) How do we train educators in creative invention?
d) What are the stumbling blocks to 'inventivity'?

We will briefly report on these areas next.

2   Nature vs. Nurture: Can Creative Invention be Taught?

Understanding the nature of creativity and inventiveness and therefore how it can be fostered, was the theme of a number of papers presented at the workshop [1-3]. Alexander and de Villiers [2] suggested that prior knowledge, insight, personal development and practice, collectively influences creative ability. This was nicely summarised as partly talent, partly solid skills, understanding of the problem and requirements, planning and implementation issues, and the theories that apply to the problem and the solution.

Computer science and information systems students are taught structured methods to analyse, decompose, and to develop systems. Such rigid structures can hamper creativity, which is generally a much less structured activity. The challenge for educators then is to move from these highly organised structures, to organised, but yet creative, structures that can facilitate creative invention (see Fig. 1 and Fig. 2).
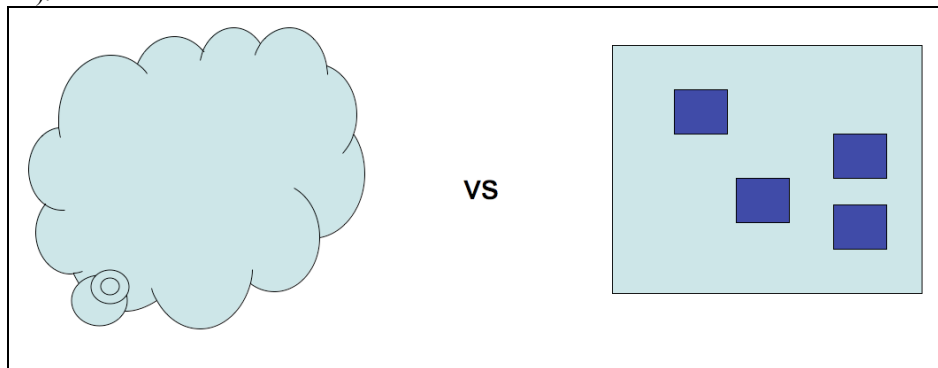

Fig. 1. *Fuzzy creative processes (left) vs. structured development processes (right).*
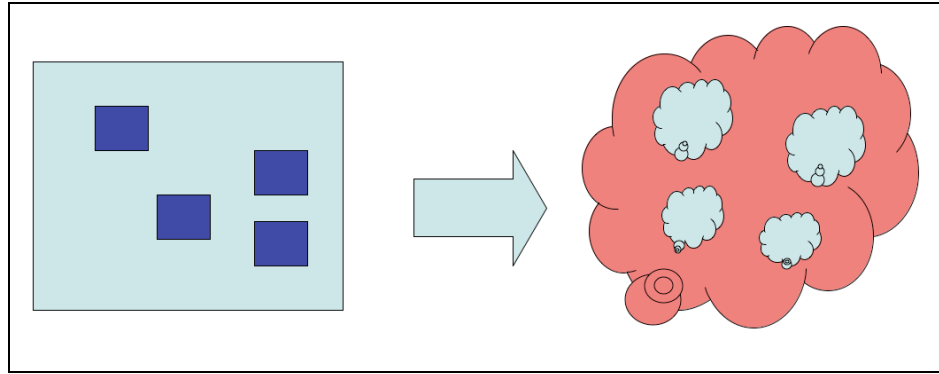
Fig. 2. *From structured processes (left box) to structures that facilitate creative invention (right clouds).*

Questions that emanate from this consideration include: Can computer science and information science students be creative? How might we influence the thinking of students and the capabilities they might use? It would seem that the answer to both these questions is 'yes', by perhaps, structuring creative processes and by giving students the needed knowledge, theory and skills to define the direction and boundaries of the invention. Wong [3] explains that part of the prior knowledge should be an understanding that invention occurs at different levels of innovation. According to Altshuler [4], this ranges from minor improvements to new concepts, and to true discoveries. Each level within this range of invention is informed by different understanding of the problem and guided by different levels of knowledge outside the problem domain.

Beckhaus suggests that to nurture creative invention, "Inventivity needs creativity ... [and creativity needs] space to develop" [1]. This is also echoed by Giovanella [5] as he reflects on his experiences in encouraging creativity in his teaching, writing: creativity cannot be forced into a restricted time window of a lecture session - it needs time and space for social interaction. Together with Wong [3], these authors provide some further suggestions for nurturing creativity within the classrooms. These suggestions include:

1. There needs to be an expectation of inventiveness in the curriculum. This would then set clear goals for how space and resources can be used so that creativity can evolve. This, when coupled with assessment, will also be a source of motivation for students to take the effort to think creatively beyond the basic deliverables. This idea of using assessments - e.g. short weekly quizzes - to motivate students to remain engaged in the process of nurturing inventivity, is also suggested by Read, Kelly and Sim [6];

2. The need for more realistic settings that reflect the complexity and serendipity of the real world and by specifying development tasks and processes that include phases for creative thinking, so that students develop a sound understanding of the domain;

3. Teaching tools and frameworks for creativity, thereby build confidence in learning to combine ideas differently, and by also providing assistance rather than interference;
4. Create classroom opportunities for 'eureka' moments;
5. Motivate students to be creative by exposing them to inventions from a variety of domains; and
6. Arrange learning environments that affords visual persistence and comparison. Such an environment affords scaffolding as ideas build upon other ideas while people compare and collaborate. Lecture-style delivery methods while acceptable for conveying information about creativity is probably less useful for developing creative thinking and representation skills.

3 What Tools and Methods are there to Help Students Learn and Develop Creative Solutions?

From the Limerick conference, it would seem that there are many tools that exist or have been developed or modified by participants at the conference to assist in teaching creativity. Dix and his colleagues [7] proposed the Bad Ideas Toolkit to help in the process of creativity. Using systematic methods to critically review bad ideas from different perspectives provides a way of training students to explore and to understand the extent and the constraints of the design space. These methods create new opportunities to make good the bad ideas, avoid design fixation, and to reduce any emotional attachments ("Hey, that's my baby you are talking about...!"), which then allow the students the freedom to re-consider or criticise earlier design decisions. Along similar lines of critique, based on the notion that 'creativity is an individual characteristic, and innovation is a social activity' Giovannella [5], proposed the use of an on-line repository, or 'lab-diary', for public brainstorming of ideas about the problem and the design concept. This lab diary would be used as a classroom tool and technique for stimulating the socialisation and sharing of ideas, resources and knowledge. Harrison and Tatar [8] described how their students were also encouraged to keep a 'design journal', not of class notes, but of design ideas and observations, and in keeping the diary, noting how their ideas develop over time. The diaries allowed the students to systematically record their reflections and insights, which could then be shared and discussed with teammates.

Lennon and Bannon [9] report using the worksheets to collate, organise and present photos and artefacts. These worksheets are then displayed on a wall in the classroom or project room to create a persistent visual environment where the key elements of the domain are continuously in view. The use of worksheets in this way allows discussions to take place within the context of the domain, reminding the students of the issues, highlighting important factors, and providing an arena for 'seeing' new relationships. The worksheet method so described was found to be a very simple technique that helped students gain insights about the problem and the environment in which the solution must succeed.

Experiences with a number of methods for generating ideas were also described. Larusdottir [10] described her experiences in using Rapid Contextual Design (RCD)

and her reflections about how new ideas were generated through the process. The contextual interviews, the affinity diagrams, and the development and use of personas and scenarios, helped the students understand the context and the nature of the problem. One of the activities in the RCD, the data walk, was used to identify missing information and highlight incorrect assumptions. A second activity, the visioning process, was used to sketch and visualise the proposed solutions, and develop paper prototypes from which to evaluate solutions. Ciolfi and Cooke [11] suggest 'cooperative evaluation' as another technique one should have in the toolset. Through the cooperative nature of the evaluation, partners think aloud in a process of co-discovery of the problems. The record of the evaluation then provides a source of reflection and insight to designers about what is good or bad with regard to the 'bigger picture'. While much can be done mechanistically, the philosophy adopted was to use this method to focus on creative thinking at each stage of the process in a cooperative manner.

'More than a method' is a suite of methods and techniques that are tightly coupled into a Project-Based Learning approach [8]. 'More than a method' emphasizes familiarity with a variety of functionally overlapping tools where their use can be orchestrated together at appropriate phases of development and idea generation. These methods include the design journal (discussed earlier), the morphological box that shows different combinations of all possible solutions, the use of sketching and representation techniques, project planning, scenarios-based design, and other methods employed with a user-centred design approach. These are similar approaches adopted by other participants at the conference [12-14].

However, good methods or even the adoption of user-centred design alone cannot compensate for a lack of creativity skills. We need to learn how to "look" for creative solutions. The methods give us new or better ways of "seeing" the problem and opportunities for framing the solution. This is what we need to teach our students: how to use them to think more creatively.

One approach suggested by Kotzé et al. [15], is to adapt the more structured software engineering methods that use patterns and anti-patterns to illustrate HCI principles. Another hybrid approach, XpnUE, has been suggested by Obendorf et al. [16]. This method fuses eXtreme Programming with usability engineering to support rapid prototyping within the framework of Contextual Design.

Flowing through these various methods are three basic themes that on the surface appear to have little to do with creative invention, but are in effect crucial aspects of 'inventivity':

1. Understanding the problem, its scope and the constraints they present;
2. Sketching, modelling, and prototyping, as techniques to visualise, represent, and explore the solution space; and
3. The need for critique and reflection using tools like the design log and on-line forums for public discussion among team members and reflection in order to gain deeper insights that can lead to creative solutions.

It appears that while methods can be compiled in a sensible manner, their use should be orchestrated in a way that would foster creativity, so that students should learn to use them to avoid thinking in a rut and learn to develop creative alternative solutions.

4   How do we Train Educators in Creative Invention?

How does one teach what one has not grasped? Students learn best from those who are masters of what they teach. While we as educators can learn about creativity, how do we experience it and become masters of creativity ourselves?

In addition to knowing about and understanding the process of creative invention and having knowledge of the methods that can help in the process as discussed above, perhaps we as educators should also practice what we preach to master the art. Wesson [17], and Wooley and Gill [13] both cite the "Six Golden Rules to Shake the Students' Minds" that arose from the 1999 IFIP WG 13.1 Workshop [18]. These 'rules' were intended for students to experience design in HCI in addition to learning the theory related to HCI and its practical applications. These 'rules' are:

1. Read thought-provoking literature.
2. Observe real users using real tools.
3. Analyse the findings in the observation.
4. Mix the results from the analysis with theory.
5. Redesign the artefact.
6. Iterate the observation phases.

These 'rules' were postulated as a guide to stimulate thinking among our students (although the workshop's focus was distance learning students, the ideas apply just as well to all students), to challenge their assumptions, and to think creatively about developing solutions.

Although the Six Golden Rules apply equally well to faculty, there are a number of other suggestions that can help develop creativity amongst educators. They include:

1. *Be inspired, observe, and practise*: The need for "... space to develop" [1] creativity and inventiveness. We need space to challenge ourselves; one method might be to read thought provoking books as suggested by the Six Golden Rules. For example, being inspired by seeing examples of creative inventions in 'Humble Masterpieces: 100 Everyday marvels of design' [19], and then considering how simple inventions such as the teabag, the compact disc, the bar code, have changed our lives, might widen our creative thinking. Educators should also regularly practise observation and being actually involved in observation and research, reflecting upon what we observe from the perspective of creative problem solving. What we are suggesting here is that as educators, we need to develop expertise and familiarity with the toolsets and how we use them.

2. *Experiential learning*: Sas [20] provides another perspective that, although intended to apply to students, can equally apply to faculty. Viewing design as being both about craftsmanship, and about being a profession, is useful. While the knowledge and the formal aspects of design can be taught (methods, frameworks, theories and concepts), much of what a good designer knows and does, needs to be learnt experientially. Some designers learnt this through an (formal or informal) apprenticeship process, by watching and learning by example and mentoring. If educators want to develop the skilfulness of creative design and invention, some degree of apprenticeship will be useful. Sas also suggests that constructivism, where understanding is constructed by personal

experience, and reflecting on these experiences, and experiential learning (concrete experience, reflection, abstract conceptualisation and active experimentation) should be encouraged within the context of situated learning, within a community of practice.

3. *Be part of a community of practice*: Perhaps this underlies the need for a community of practice in 'inventivity' among educators, to practise and to experience first hand, to mentor and to apprentice, to hone and to refine, our expertise in creative inventiveness. Such an approach underlies the organisation of the HCIEd 2007 Creativity: Experiencing to Educate and Design Conference. Thus, we as educators need to create the space to learn the knowledge, to develop the skills of creative invention, and learn to see opportunities for creative interventions.

5   Stumbling Blocks to 'Inventivity'?

Quite naturally, a lack of attention to the issues raised earlier in this paper, can present problems to learning, teaching and being good at inventivity. Edwards, Wright and Petrie [21] asked the question, "Why is HCI education failing?". The paper provides some evidence of failure, and suggested some answers why. The reasons they cite have provided some insight to the stumbling blocks we face in teaching inventivity, and in being good at it. Some of these stumbling blocks are not as obvious as we might think they should be. We briefly describe some of these stumbling blocks.

1. *It's all common sense*: Anyone with some common sense should be able to design an interface or design an adequate solution.
2. *HCI is 'soft'*: I.e. no hard programming nor difficult maths, and that design is also 'soft', as there are no 'right' answers, and HCI design is therefore easy.
3. *Being creative and being artistic*: We sometimes confuse being creative with being artistic. 'Creative types' are seen to create and design attractive and aesthetically pleasing interfaces. Creative invention is about devising innovative solutions that work, not just pretty or artistic interfaces, although this plays a significant role in the design of engaging software. Similarly, being able to create software, as all programmers do, is not the same as being able to think creatively to devise new concepts and innovative solutions that can be programmed. Hence developing a piece of software that works is quite different from designing software that works in an innovative way.

6   Conclusion: Where to Next?

As educators, how do we progress the teaching and experiential learning of creative invention? In this chapter we have outlined a number of issues. In this concluding section, we summarise some lessons we have learnt that we hope will guide our future efforts:

1. Nature vs. nurture: While some of us are more creative and inventive than others, as educators we can use what is known about creative invention to develop the classroom environments to encourage and to nurture its growth.
2. Tools and methods: We should adapt and re-purpose existing tools and methods, and orchestrate them in a way that would foster creativity so that they help us understand and scope the problem; visualise and explore the solution space; and critique and reflect in order to gain the insights that can lead to creative solutions.
3. How do we train educators in creativity? Just as we would train our students: inspire them, teach them to observe, and practise it in order to experience it.
4. Humans are creatures of habit. Make creative and inventive thinking part of our routine problem solving and design behaviour. Develop our skills in using a suite of creativity tools and techniques for analysis to see the problem and constraints in different ways, and for visualisation and design in order to quickly see how the designs would address the problem.
5. While good designs will arise from good intentions and ideas, not all good intentions and good ideas lead to good designs. We need to recognise this so that we avoid discarding good ideas because of a poor implementation.
6. User-centred design approaches do not necessarily lead to good designs either. UCD helps us focus on the user and the context of their work, which we can then build upon to deliberately and consciously devise creative and inventive solutions.
7. Lecture style teaching is acceptable for learning about creativity, but is not suitable for developing creativity skills in the classroom.
8. Creative invention is more than artistic creativity and the creation of visually attractive interfaces. It is about finding inventive solutions to problems.
9. Stumbling blocks to *inventivity* are often not obvious.

In closing, to teach creativity and inventivity, we as educators need to experience it ourselves – a key issue in the planning and organisation of HCIEd 2007. As educators, we too, need to be good at it.

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