AN UNEXPECTED JOURNEY: EXPERIENCES OF LEARNING THROUGH EXPLORATION AND EXPERIMENTATION

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ABSTRACT:

Historically, the majority of approaches to post-secondary education are grounded in the same viewpoint. Students are introduced to specific techniques and are encouraged to apply these in the pursuit of directed learning. There has been a recent emergence of constructivist approaches propose students are capable of creating their own knowledge. Constructivist approaches are normally framed in terms of project-based frameworks. Students are provided a problem that directs their learning journey and creates a perceived need that engenders positive learning. However, there is often an implicit bias in the project that constrains the learning either in terms of the processes used or the expected outcomes leading to predictable outcomes that do not foster divergent thinking and creativity. This paper outlines experiences gained in promoting student-driven design teaching that focuses on whether learning can be more effective in the long term by embracing failure.

Keywords: Explorative learning, Experimentation, Failure

1. INTRODUCTION

This paper outlines experiences of a number of staff who have embraced the constructivist model of learning in the teaching of design, technology, entrepreneurship and visual arts. It is our view that many educators who "talk the talk" of constructivism do not fully grasp the full potential of the approaches. Academic literature is full of case studies that espouse the value of project or problem-based approaches and yet in their implementation the project or problem specification in some way constrains the expected outcomes to a "safe" zone. The question we ask is whether such constraints can be removed to allow students to define their own learning journey through a process of exploration and experimentation, and in doing so embrace risky options and learn through the process of failure.

This is not a traditional academic paper; in a way it is an experiment and an attempt to explore different ways of collaborative writing and knowledge dissemination. We have chosen to forego placing our writing in the context of a body of literature, though we could do so as such literature exists - albeit with many educational studies choosing to focus on

the positives and quietly sweeping the failed projects under the carpet. We also have no hypotheses to test, instead our paper is written in the form of a number of "monologues" where our authors recount a range of teaching experiences that accommodated student exploration and experimentation through open-ended learning experiences. The paper therefore typifies our beliefs that it is ok to try things that might fail, that playing it safe is not the best way to learn or to advance. From our disparate experiences we extract some common themes that come together in the form of a manifesto for future developments around a transdisciplinary, action-oriented, experience-oriented, constructivist-grounded approach for teaching design, where the emphasis is on the promotion of risk taking and the non-penalisation of projects that do not apparently succeed. In a sense our approach is truly interpretivist as this manifesto can be viewed as a tentative hypothesis derived from observed patterns. Further work will expand on this manifesto and implement it in practice to provide concrete support for the manifesto.

2. EXPERIENCES OF LEARNING THROUGH EXPLORATION AND EXPERIMENTATION

The following sections each outline one author's experience of students learning through exploration and experimentation.

2. 1. SYSTEMATISING CREATIVITY: AN ENGINEER AFLOAT IN A SEA OF ARTISTS (ANDY)

I'm an engineer. I'm not proud of it, I'm not ashamed by it. It's just in the blood, a way of looking at the world and thinking about design problems that can be hard to escape. In a way, engineering design is antithetical to other design approaches. Rather than promote and encourage creativity, the teaching of engineering design is intended to constrain and harness creativity to prevent failures in the real world. In many institutions engineering design is taught backwards, with detailed design (the final stage of the actual design process) being taught first, whereas conceptual design is taught last. As an undergraduate student this reverse thinking was not lost on me and did not seem right. A final year design project brought this home even further. An innovative solution to a design problem led to a failing grade for the project, in part through my failure to communicate my design intent but also through my lecturer's inability to see the value in an unexpected outcome.

The traditional approach to teaching engineering design is therefore to start with "design in the small", understanding orthographic projections, understanding how to calculate a thread pitch to withstand a particular shear stress and so on. As an engineering student progresses through their studies they are introduced to "design in the big", how to generate and evaluate solution concepts to a problem. This cycle of generate and evaluate is intended to promote exploration of the design problem, but restrict the solutions to those that are not going to fail. Students are introduced to a range of design techniques that can be used to generate design concepts. But are they using these tools to their full advantage? Or are they limited by their perception of what design is as a result of their early education? Certainly

my own experience in commercial, interdisciplinary engineering projects suggests that a traditional engineering education fails to adequately prepare graduates for complex, real world problems. In contrast to engineering, creative design is often based on an intuitive, almost leap of faith basis that can be likened to black box processing of design related information in order to produce a variety of design outputs, some of which will be 'creative'. Whilst creativity tools exist, often they are not deployed in the creative design process. This begs a question, what happens when you take a set of design tools intended to guide engineers to widening their viewpoint of conceptual design and put them in the hands of creative designers?

The "Fly High" project did just that, introducing first year Creative Technologies students to a number of design approaches from the engineering discipline, including what engineers call "functional decomposition and morphological analysis". Functional decomposition is used to identify the features of a design and morphological analysis is used to combine alternative means to implement each function in order to create a unique solution concept. In this project, students were asked to design a new flying machine using this technique where design features would include aspects such as provision of lift, propulsion etc. The outcomes were fascinating, with many students embracing the approach and realising that a systematic approach to design doesn't preclude creative solutions and in fact offers the ability to be more creative as a result of innovation emerging from recombination of solution components that would not have emerged intuitively. As one student exclaimed "We've got over 7000 possible concepts after just an hour of thinking!". Of course, with the introduction of new approaches there always students who don't realise the potential. As one student commented in the project reflection "I thought this broke up the individual parts too much so I couldn't think of how all the parts should go together. The design turned out differently than it would have if I has done it the usual way. It's hard to say whether that it is better or just different?"

The project provides an insight into transdisciplinarity based education. It is arguable whether true transdisciplinarity can arise without some understanding of the disciplines that underpin it. In some ways, an approach to transdisciplinary education can be as simple as taking tools, thinking or approaches from one discipline and applying them in a completely different context. Yes, not all students will see the value. Not all will use the tools to reach a successful outcome, but there at least is an emergence of understanding of how others view the world and approach design problems. It creates an awareness of language that must precede a dialogue and opens the door to more rich communication.

2. 2. CREATIVITY AND LATERAL THINKING IN TRANSDISCIPLINARY LEARNING ENVIRONMENT (SANGEETA)

I'm going to share my experience in teaching user and student-centric design approach across the art, design and business disciplines. I am from business management background but I teach design across many disciplines such as business, graphic design,

entrepreneurship and creative technologies. I am not good at drawing but that doesn't stop me thinking like a designer. I believe a designer is one who solves the problem and finds solutions in a creative way. My class consists of students from different disciplines such as marketing, graphic design, hospitality, engineering and accounting. It is a good mix of students from various disciplines with different level of creativity, storytelling, risk taking, openness and ability or willingness to communicate with fellow students from another discipline.

Every day new technologies are being developed that can change users behaviour and increase their decision making power. As we are living in the digital era, users have more access to information, services and have more power to assess what they want. As a result the way we approach teaching in design is changed. It is more practical and hand on approach. In modern design, the overall design and the delivery of the content are user focused and the teaching of design needs to be similarly student focused. Just as the needs and wants of the users are assessed before deciding the media of delivery for a design project, the needs and wants of students need to be considered before deciding the delivery of a design course. Most design projects uses tools such as lotus blossom, persona, co-creation and empathy analysis to understand and build empathy with users. Art students are more open and ready to explore new approaches to create empathy, ideate and prototype. Usually such students take initiatives to use new approaches to come up with a creative solutions and readily embrace the risk that the outcomes may not always be predictable and safe. They are more visual communicators, good at storytelling and like to write their own story in their work.

With the rapid changes in business environments, the student centric approach has also made inroads in to business teaching. I teach business students majoring in design. Design is more about keeping the users as a centre point for designing all products and services. This provides more scope for students to explore themselves and work according to their strengths rather than following a set procedures or guidelines. Students drive their own learning through inquiry, as well as working collaboratively to research and create products together. It fosters authentic learning, motivation, creativity and engagement among students.

Teaching across disciplines I feel, business and engineering students are reluctant to work on student centric projects, as they are not used to exploring their own strengths, take risks and explore any unknown territory. They are confined to their own comfort zone and crave predictability and this restricts their ability in exploring and experimenting with new ideas. One of the reasons could be the teaching system in business and engineering disciplines. Most of the students have large classes, single disciple and lecture-based delivery. Assessment rubrics can often be defined around the expectations of the lecturer and what they expect a student to produce. Development of student centric and problem based learning has relatively less impact and as a result these disciplines restrict development of personal and collaborative ability among students that is required in today's business or

engineering industry. This has resulted in lack of communication skills and teamwork experiences to develop more opportunities for students.

As students progress from year one to three, they make real progress in their communication and teamwork ability. But not all students will be able to connect with the users and the team as they are focused on their own achievements and lack to understand the benefits of wider network. This is more common in areas such as business and engineering than creative and artistic environment.

2. 3. THE IGNORANT TUTOR: A BUSINESS GRADUATE TEACHES DESIGN IN A FINE ARTS SCHOOL (CHRIS)

I recently created and taught a six-week design studio course for second-year fine arts students. I'm a weirdo. But that doesn't mean I'm an artist. I have a Masters degree in international business and spent two years as a postgraduate research student in an innovation research institute (let's not go into why I was asked to teach this course!). The course was intended to provide students with technical skills in desktop publishing but fragmented into a series of individual student-led explorations of varying degrees of success.

As a business student, I graduated with little experience in educational settings that valued self-directed learning, exploration, and experimentation. This inexperience magnified the stereotypes I held of art school as a zone of freeform learning and led me to create a course with what turned out to be minimum structure and guidance when compared to other disciplines (e.g. painting, printmaking, ceramics, etc). Further, unfamiliarity with the specific institution led to a clash of 'insider' and 'outsider' common sense with other staff, and opacity in aspects of my course development and facilitation. For their part, the second-year students were equipped with basic knowledge of institutional norms but were still new enough to the school that they lacked confidence (and thus were not bound to 'best practice') in navigating studio practice, project tracking, and assessment rubrics.

This double-edged inexperience fostered a co-learning of the educational space which necessitated a continual feeling out of the terrain and resulted in sustained uncertainty and low-level anxiety for me, students and other teaching staff.

My role devolved into one of companionship, support, and institutional interface. In this sense I became like Ranciere's 'ignorant schoolmaster' - unwilling (unable?) to explicate in the art/design context but able to confirm whether the student had searched. Students were forced to develop their own project focus and methods, and then follow them through to their own outputs (ranging from ceramics and sexual videos to flower arrangement and mind mapping). This left little time for 'making'. Other disciplines had set deadlines, focused conceptual fields and legible terrains laid out for them at the beginning but it took most of 'my' students half of the 6-weeks to get to the same stage by themselves, resulting in less polished final works. Students that could not 'deal with themselves' struggled to produce anything. Further, little technical learning in desktop publishing was accomplished.

Despite all these acknowledged failures the benchmarked distribution of marks did not differ from that of other disciplines, indicating (perhaps unfortunately) that students did not 'fail more'. Similarly, feedback from the programme director, students and fellow tutors gives me some peace of mind regarding my success or failure as a 'teacher'.

We all spent the course on the edge of a precipice, but this project offers one example of how 'ignorant schoolmaster' experiments (not just in teaching and course design but in hiring and professional development practices) can create coalface opportunities for questioning disciplinary egocentricism and 'safe zones' for both staff and students.

2. 4. SMOKE AND MIRRORS (STEFAN)

Both my Master's Thesis and my PhD Thesis were failures. Not in a sense that I wasn't able to finish them, but in a sense that I didn't achieve the goals I set out to "prove". My virtual neural-network-driven physically simulated and genetically evolved creatures were not able to learn to walk by themselves, but instead found every gap and flaw in the physical simulation and genetic fitness formula that I used. My serious game for medical teamwork training did not significantly improve the time teams needed for completing medical tasks, but kept it exactly equal. At least, users reported a higher realism.

I don't want to miss these "alternative outcomes". I learned a lot by trying to understand them, probably more than if things would have worked out perfectly. I have stayed true to honestly reporting my outcomes without trying to interpret or discuss weak results "away". As a result, I have a better trained eye for critically analysing other scientific work and student's results. But it has also made me more sympathetic towards students who attempt something new and daring and don't get the expected outcome or face unexpected difficulties. If possible, I am trying to turn those students' experiences into learning opportunities as happened in the following case:

A group of students had designed an "Electronic Garden" which used a variety of motors, servos, and other actuators. Everything was working rather well, but on the day of submission and marking, we lecturers found a note saying that we were supposed to only turn it on when marking and turn it off immediately afterwards due to "unexplained heat problems". When talking to the students and analysing their circuitry, I found several problems in the power design and code, leading to overheating components and motors (at that time, I had just started my job as lecturer in Creative Technologies, so I was not involved in the initial design process of this installation). Although this problem did not reflect negatively on their final marks, it affected their final installation in a way that would have made it unsuitable - if not dangerous - for a public exhibition. Furthermore, the students came to very drastic conclusions for their future work by formulating generic statements like "You can't use component X together with Y".

In the next semester, I encountered another group of students preparing a project that required a similar setup. However they seemed intimidated by those aforementioned generic

statements and were struggling with alternative solutions. By that time, I decided to turn the problem into a learning experience for the affected as well as for all other future groups. First, I created additional material for the first year Physical Computing paper and incorporated the problem analysis and possible solutions into the curriculum. Second, I sat down with the initial group and discussed these solutions with them, helping them to understand the exact nature of the problem and refine their statements to "You can use X with Y, if you ensure that…". Third, I took this knowledge to the struggling group and together, we were able to develop solutions for their installation as well.

In the last two deliveries of the Physical Computing paper, it was quite helpful and relevant to the students to hear about what problems other groups before them had faced and how they were able to analyse and solve those, providing experience and knowledge for the future student cohorts

3. DISCUSSION

The previous section outlines some of our experiences teaching trandisciplinary courses where we encourage students to be experimental, explorative and to take risks. From these experiences, and others not recounted here, we extract recurrent themes in the form of a manifesto for embracing and encouraging failure.

3. 1. BE PREPARED TO FAIL YOURSELF

In our experience it seems that educators who have in some failed in their own education or experiences are more open to consider failure as a positive learning outcome. We are firm believers in affective teaching, which we use in this context as describing the ability of an educator to change the behaviour and feelings of their students by role modelling particularly behaviour or characteristics themselves. An effective educator is one who is a lifelong learner themselves, willing to try new things and see if they work. Sometimes such things will not work, or at least not as intended. By pushing yourself to take bigger risks in designing and implementing courses and not being set back by failures will positively influence your students to take risks and experiment themselves.

3. 2. DON'T FAIL A "FAILURE"

It's easy to design marking rubrics that identify what characteristics of an assignment will lead to a passing grade, but in their own way such rubrics constrain student thinking to addressing the marking criteria as opposed to trying to understand and address the underlying problem in a creative way. It is important to evaluate all student work on its own merits and indeed it makes sense to involve the students themselves in setting the criteria against which a piece of work will be assessed.

3. 3. EXPLORE AND EXPERIMENT

It's a recognised phenomenon that "teachers teach as they are taught" and this can understood by considering the principles of learning. The principal of primacy implies that when an educator has no training to change their behaviour, they revert to their earliest knowledge of teaching in a given environment which is normally how they learned. This behaviour is easily changed by simply changing the environment, perhaps changing disciplines. All of the authors of this paper have operate on the fringes of our original disciplines and been exposed to different approaches to teaching and learning as a result. We work as a collective that supports and learns from each other and are always willing to try something new. That transdisciplinary synergy creates a whole that is much stronger than the sum of the parts.

3. 4. BELIEVE IN YOUR STUDENTS

The students of today are digital natives, used to a world where unlimited information is available at the click of a mouse or more likely the swipe of a finger. Their potential to assimilate large volumes of information and filter out useful knowledge quickly is significant. Secondary education has undergone a renaissance in many countries, with the emergence of inquiry led curricula becoming the norm. Your students are capable of great things if you let them try. Don't feel the need to constrain projects or process, open them up and ask students to see the potential for carrying their work further and incorporating their own interests into their work. Don't squash their ideas just because they don't fit with your world view or don't look like they will work. Let them try, you might be surprised at what happens.

3. 4. HIT THE STREET

Over recent years almost every one of the boundaries which gave definition to a traditional university experience have shifted, particularly in terms of the time, place and identity of study modes. The experience of "university life" and the kind of learning which takes place between registration and the award of the degree is much broader and no longer confined to the classroom. It becomes important to then ensure that the real world is brought in to the classroom in a way that enriches the student experience and engages students in classroom activities.

3. 5. TRANSFORM LEARNING SPACES

This is not intended to be meant literally, though there is also significant value in the creation of new, multi-functional learning spaces. But it is more of an overarching meta-change in culture. Yes, we want students to drive their own learning. Yes, we want students to take risks. Yes, we want students to fail, without failing. But that does not mean that we want students to become blasé. Like Icarus, we want them to fly close to the sun but we don't want them to drown when they fall into the sea. We need to transform learning spaces

so that they are unreal and failure has few implications in that space, but the real world context is discussed to help students learn to consider whether risk is acceptable and understand the consequences of making particular judgements.

4. CONCLUSIONS

This paper has outlined the experiences of a group of educators in terms of the creation of transformative learning spaces that encourage students to take risk and to consider project failure as a positive learning experience. Common themes from these experiences have been distilled into a short manifesto for future developments around a transdisciplinary, action-oriented, experience-oriented, constructivist-grounded approach for teaching design and technology. It is our belief that such a learning environment is appropriate for learners of the digital native era and prepares students with the skills and attitude required to be able to develop creative solutions to so-called "wicked problems" of the future.